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CHAMBERS'S

ENCYCLOPÆDIA

A DICTIONARY

OF

UNIVERSAL KNOWLEDG

NEW EDITION

VOL. V.

FRIDAY TO HUMANITARIANS

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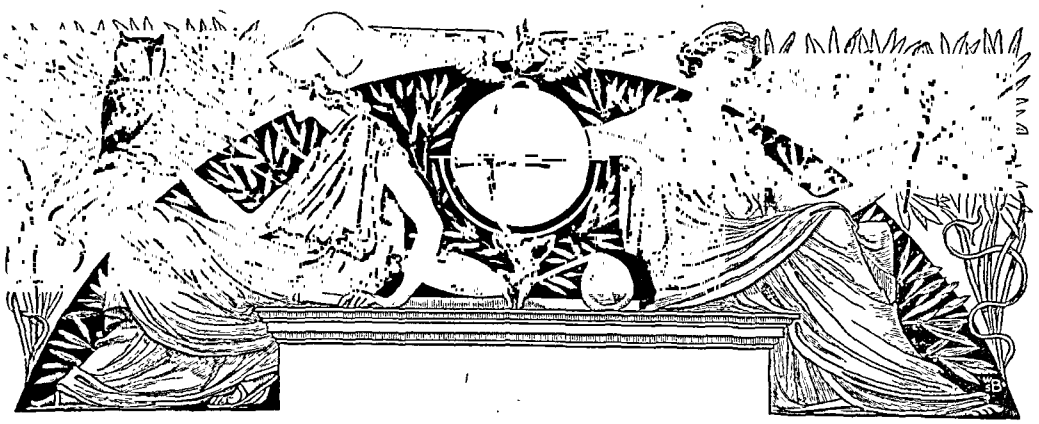
Among the more important articles in this Volume are the following:

The Publishers beg to tender their thanks, for revising the article 'Fungi,' to Mr George Murray; for 'Girton College,' to the Vice-Mistress; for 'Gray,' to Mr Gosse; for 'Grégoire,' to Professor Caspar René Gregory; for 'Green (J. R.),' to Mrs Green; for 'Greenock,' to Ex-Provost Campbell; for 'Harrow,' to the Rev. J. C. Welldon; for 'Heredity,' to Francis Galton, Esq.; for 'Hereford,' to the Hon. and Very Rev. Dean Herbert; for 'Hobbes,' to Professor Croom Robertson; for 'Howard,' to Walter Rye, Esq.; for 'Huddersfield,' to Mr G. B. Nalder, Town-clerk.

MAPS FOR VOL. V.



CHAMBERS'S ENCYCLOPÆDIA

A DICTIONARY OF UNIVERSAL KNOWLEDGE

Friday (Lat. *Dies Veneris*, Fr. *Vendredi*, Ger. *Freitag*, Swed. *Fredag*), the sixth day of the week, takes its name from the goddess Frigga, the wife of Odin, to whom it was consecrated. The word is, however, often connected with Freyja, the goddess of love, to which notion the Latin name is due. As the day of the week on which the Crucifixion of our Lord took place, it has had a special sanctity among most Christian peoples, and Roman Catholics still hold it as a weekly fast. The Friday in Holy Week is the day on which the Passion is especially celebrated, and as such is the most solemn of the festivals of the Christian church. Almost everywhere within the range of Christendom, Friday is a day of proverbial ill-luck, on which it is not wise to put to sea, to marry, or commence any important undertaking. In some places other days are unlucky for particular enterprises, but Friday holds its character everywhere and for undertakings of all kinds. Among no class of men is this notion more persistent than among mariners, who, whether Spaniards, Italians, Bretons, Finns, or Englishmen, alike manifest the same disinclination to put to sea that day; and recount many a story of disaster that has followed some too greatly daring crew, the memory unconsciously retaining the few confirming cases, while the many exceptions are easily forgotten. A persistent but not localised tradition in both England and America tells of a ship, the keel of which was laid on Friday, that was launched on Friday, with the name of Friday, and sent to sea on Friday, under a Captain Friday, but which deservedly was never heard of again. Shipping statistics still show a smaller number of sailings upon that than upon any other day—it may be well for sailors to be reminded that Columbus both sailed and discovered land on Friday, and that the Pilgrim Fathers touched land on the same day.

Although the Russian name for Friday, *Pyatnitsa* (*pyat*, 'five'), has not a similar mythological significance with *Friday* or *Vendredi*, the day was consecrated by the ancient Slavonians to some goddess similar to Venus or Freyja. Afanasief explains the Carinthian name *Sibne dau* as indicating that it was once holy to Siva, the Lithuanian Seewa, the Slavonic deity corresponding to Ceres. In Christian time the deity presiding over Friday became merged in St Prascovia, and is now addressed under the compound name of 'Mother Pyatnitsa-Prascovia.' She wanders about the house on her holy day, and is displeased to see sewing, spinning, weaving, and the like going on, revenging herself by plagues of sore eyes, whitlows, and agnails. Especially must the house be clean of dust on the Thursday evening, so that she may not be offended on her visit the next day.

Frideswide, ST, the patroness of Oxford, was born there early in the 8th century, the daughter of Dida, an ealdorman. She preferred the religious life to marriage with Algar, a great Mercian noble, who, coming in search of her, was struck blind. She died on 14th November at Oxford (q.v.), and was formally canonised in 1481. Catherine, Peter Martyr's wife, was buried beside her pillaged shrine in 1552, exhumed by Cardinal Pole, but reinterred there in 1561, when the remains of the virgin saint and of the ex-nun were indissolubly mingled together. See F. Goldie, S.J., *The Story of St Frideswide* (1881).

Friedensville, a small post-village of Lehigh county, Pennsylvania, 6 miles SE. of Allentown, with a rich zinc mine and a famous pump, that raises nearly 30,000,000 gallons of water daily.

Friedland, a town of East Prussia, on the Alle, 26 miles SE. of Königsberg, with 3182 inhabitants. It is famous as the scene of Napoleon's victory, on 14th June 1807, over the Russian and Prussian forces under Bennigsen, which brought about the Treaty of Tilsit.—FRIEDLAND is also the name of a town in the north-east of Mecklenburg,

with 5502 inhabitants, and of a manufacturing town in the north of Bohemia, on the Wittig, 16 miles N. of Reichenberg by rail, with a pop. of 4817. The last gave name to the duchy from which Wallenstein (q.v.) took his title of Duke of Friedland.

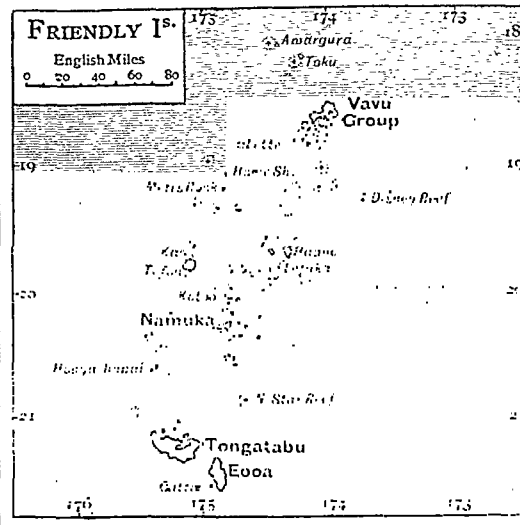
Friedland, VALENTIN, a remarkable educationist, generally called *Trotzendorf*, from his birthplace, near Görlitz, in Prussian Silesia, was born 14th February 1490. At Leipzig he studied Latin under Peter Mosellanus and Greek under Richard Crocus, and he began his career as a teacher in the school at Görlitz. On the dawn of the Reformation he proceeded to Wittenberg, and studied under Luther and Melanchthon. Settling at Goldberg, in Silesia, as rector of the gymnasium there in 1531, Friedland introduced into his school a novel system of instruction and of discipline, which soon spread the fame of the institution through all the adjoining countries of Europe. The principal feature of the disciplinary system was that the preservation of order and decorum was left in the hands of the boys themselves. Instruction was imparted through the medium of academic discussions, coupled with frequent repetitions and examinations. Friedland died, 26th April 1556, at Liegnitz, whither he had removed his school two years before. See the biographies by Herrmann (1727), Frösch (1818), Pinzger (1825), Köhler (1848), and Löschke (1856).

Friedrich, JOHANN, a Catholic theologian, a leader with Döllinger in the Old Catholic movement. Born in Franconia in 1836, he became a professor of Theology at Munich in 1865; assisted at the Vatican Council in 1870; and subsequently, in life and labours, has been identified with the Old Catholics (q.v.).

Friedrichroda, a town of Thüringen in the charming Schilfwasser valley, 13 miles SW. of Gotha by rail, is a favourite summer-resort, receiving some 7000 visitors yearly. Here is the Duke of Gotha's beautiful country seat, Reinhardsbrunn, on the site of the old abbey of that name, destroyed in the Peasant War. The town has bleaching establishments and large laundries, supplied from Magdeburg, Berlin, Hamburg, &c. Pop. 3146.

Friedrichsdorf, a town in the Prussian province of Hesse-Nassau, on the southern slope of the Taunus, 3 miles NE. of Homburg. It was founded in 1687 by thirty-two Huguenot families, and its 1189 inhabitants still speak French.

Friendly Islands, or TONGA GROUP, lie 250 miles ESE. of Fiji (q.v.), number 32 inhabited and about 150 small islands, and consist of three sub-groups, with a collective area of only 385 sq. m. Tonga-tabu (130 sq. m.) is the largest; and next in importance are Eooa, Vavu, Namuka and Lefuka, Tofoa, Late, and Kao. The great majority are of coral formation; but some are volcanic; there are several active volcanoes, such as Tofoa (2781 feet) and Late (1787); and earthquakes are frequent. During a severe volcanic disturbance in October 1885 a small island 20 miles north-west of Honga Hapai was upheaved, and named Sandfly Island, after the government schooner which first visited it. A treaty was concluded with Germany in 1876, with Great Britain in 1879; and the convention signed at Berlin in 1886, defining the British and German possessions in the Western Pacific, provides for the neutrality of this archipelago. The Friendly Islands were discovered by Tasman in 1643, but received their collective name from Cook, who visited them in 1777. Both these navigators found the soil closely and highly cultivated, and the people apparently unprovided with arms. The climate is salubrious, but humid; hurricanes are frequent. Among the products of the islands are tropical fruits, copra, coffee, sponges, cocoa-nuts, and arrowroot. The imports in 1888 amounted to £48,736, and the exports to £66,473. The flora resembles that of the Fiji group; but the native animals are very few. In the south part of Tonga-tabu there is an ancient monument of two



perpendicular rectangular blocks of stone about 40 feet high, with a slab across the top, and thereon a stone bowl. The stones must have been brought by sea.

The Friendly Islands were first visited by missionaries in 1797. In 1827 the work of evangelisation fell into the hands of the Wesleyan Methodists, and, after a lengthened and perilous struggle with the savage paganism of the inhabitants, it was crowned with success. Almost all the islanders (who, unlike the Fijians, belong to the fair Polynesian stock) are now Christians; many can speak English, and schools are numerous. In mental development, skill in house-building, and in the preparation of weapons, dress, &c., they are superior to other South Sea islanders. They are, however, decreasing in numbers; once estimated at 40,000 or 50,000, they had dwindled to 22,937 in 1884. The various islands used to be governed by independent chiefs, but in 1845 they were brought under the rule of one chief, called King George, an able ruler, and a zealous preacher of the gospel. In 1862 he gave the islands a 'constitution,' and summoned a parliament of forty members. See H. S. Cooper's *Coral Islands* (1880).

Friendly Societies. The prototype of the modern friendly society has been found in the medieval trade or craft guilds; and there is some connection between the older specimens of the village benefit club and these guilds, which were the friendly societies of their day. During the nonage of Edward VI. the craft guilds were disestablished and disendowed (their revenues becoming the prey of greedy courtiers); but there are traces in some rural districts of England that the convivial, if not the beneficial, aspect of the old guilds survives in the annual feast of the village club. The germ, however, of the present system of mutual provident associations under the friendly society form is contained in Defoe's *Essays on Several Projects* (1696), in which the author of *Robinson Crusoe* advocated the promotion of 'societies formed by mutual assurance for the relief of the members in seasons of distress . . . by which not a creature so miserable or so poor but should *claim subsistence as their due, not ask* it of charity.' Indeed, it would seem as though Defoe was only seeking to extend the operations of

a species of thrift institution already in existence, since we find a London society founded in 1687 among the dozen known survivors of benefit clubs established during the last quarter of the 17th and the first half of the 18th century. The Ancient Order of Free Gardeners is of considerable antiquity in Scotland, the oldest known lodge being that of Dunfermline, the charter of which dates from 1715.

This form of provident insurance is peculiar to the English-speaking race, and is the invention of the industrial classes of Great Britain, as the means whereby they have supplied their economic needs for themselves by themselves, '*no* man showing them the way, not by prescription of law, not by influence of superiors.' In 1793 the legislation first recognised the expediency of protecting and encouraging friendly societies, and enacted 'that it should be lawful for any number of persons in Great Britain to form themselves into and to establish one or more society or societies of good fellowship, for the purpose of raising from time to time, by subscriptions of the several members, a stock or fund for the mutual relief and maintenance of all and every the members thereof, in old age, sickness, and infirmity, or for the relief of the widows and children of deceased members' (Rose Act). And a parliamentary committee of 1825 excellently gives the *raison d'être* of the mutual friendly society as compared with the individualistic savings-bank: 'Whenever there is a contingency, the cheapest way of providing against it is by uniting with others, so that each man may subject himself to a small deprivation, in order that no man may be subjected to a great loss. He upon whom the contingency does not fall does not get his money back again, nor does he get for it any visible or tangible benefit; but he obtains security against ruin, and consequent peace of mind. He upon whom the contingency does fall gets all that those whom fortune has exempted from it have lost in hard money, and is thus enabled to sustain an event which would otherwise overwhelm him. The individual depositor, not the contributor to a common fund, is really the speculator. If no sickness attacks him during his years of strength and activity, and he *dies* before he is past labour, he has been successful in his speculation; but if he fall sick at an early period, or if he live to old age, he is a great loser, for his savings, with their accumulations, will support him but a short time in sickness.' What the Rose Act of 1793 was to societies that existed in the last decade of the 18th century the enabling enactment of 1829 (10 Geo. IV. chap. 56) was to societies which belonged to a more developed period of history. Much of the efficiency and good working of this act was due to the new departure taken by its sponsor, Lord Portman, then M.P. for Dorsetshire, in putting himself into communication with representatives of those bodies for which he purposed to legislate. The Act of 1829 'forms the transition from the system of local to that of central registration,' and the supplementary Act of 1834 carried centralisation a step further. Prior to the date of the former act a provincial system of registration and returns prevailed, each clerk of the peace holding the office of registrar for his several county, the rules being certified and the scales of contributions passed by the county magistrates. But henceforth three registrars of co-ordinate authority for England, Scotland, and Ireland were appointed. The provision requiring justices to be satisfied that the tables of contributions and benefits might be 'adopted with safety to all parties concerned' was repealed; but, in view of existing imperfect and inefficient data in the matter of vital statistics, societies were under the obligation of making quinquennial returns of their sickness and mortality experience. The following privileges of the Act of 1793 were confirmed: power to recover funds from defaulting officers by summary proceedings; priority of claims for moneys on the assets of any deceased or bankrupt officer or trustee; power to determine disputes by arbitration, and of justices to enforce compliance with the ruling of the arbitrators; exemption of stamp duty on bonds.

The Victorian era was contemporaneous with the financial period in the history of the friendly society system. Hitherto societies had been rather benevolent than benefit, more convivial than financial, in their status. But with Mr Charles Ansell came the dawn of actuarial light on the friendly society world. The purely scientific principles laid down by Mr Ansell were rectified and extended by Mr Neison the elder, in his *magnum opus*, *Contributions to Vital Statistics* (1845). Five years later appeared *Observations on the Rate of Mortality and Sickness amongst Friendly Societies*, &c., with a series of tables showing the value of annuities, sick gifts, assurance for death, and contributions to be paid equivalent thereto, calculated from the experience of the Manchester Unity of Oddfellows, by Henry Ratcliffe, corresponding secretary. The outcome was the famous 'Ratcliffe Tables,' subsequently corrected by the compiler, and endorsed by the Royal Commission of 1871–74 as the soundest and most reliable tables extant. Thus twenty-five years prior to the Friendly Societies Act of 1875 (which embodied the recommendations of the commissioners), making a valuation of assets and liabilities compulsory, the late secretary and actuary of the Manchester Unity laid down the true principles of financial security, and prepared the way for a process of self-reform in the society which it would be difficult to match in the history of any other public and corporate body. The classification of the various trades of members occupied Mr Ratcliffe from 15 to 17 hours per day, and 1,321,048 years of life were brought under observation. It was not until 1850 that the affiliated class of friendly society received legal recognition under a temporary act, which became, five years later, a permanent measure (18 and 19 Vict. chap. 63). Prior to this date they had been illegal combinations, coming under the clauses of the Corresponding Societies Act (39 Geo. III. chap. 79) and of the Seditious Meetings Act (57 Geo. III. chap. 19). The legal recognition was, however, of little use to the affiliated societies, since the then newly-appointed registrar, Mr J. Tidd Pratt, in opposition to the spirit as well as the wording of the act, refused to allow the registration of branches of the orders, except as separate and isolated societies —a misruling which was not corrected, so far as branches registered under this act and not registered under the Act of 1875 were concerned, till 1886 (Supreme Court of Appeal: Scholfield and others *v.* Vause and others). The only other alterations of importance were the requirement of an actuarial certificate in the case of societies granting an annuity or superannuation benefit, and the abolition of all fees for registry. The Act of 1855 failing to bring about the beneficial results hoped for by its promoters, in 1871 a Royal Commission of Inquiry was appointed, with Sir Stafford Northcote (the late Lord Iddesleigh) for chairman and J. M. Ludlow, Esq., secretary. The labours of the Commissioners extended over a period of four years, and the recommendations of their final report (1874) were embodied in the act now in force (38 and 39 Vict. chap. 60), which, owing to the above-mentioned ruling of Mr J. Tidd Pratt, had to be supplemented by a short Amendment Act (1876), under which societies with branches (i.e. affiliated orders) could be registered as such. The following are among the principal alterations effected by the Acts of

1875–76: one chief registrar and three assistants, instead of three separate registrars for England, Scotland, and Ireland with co-ordinate authority; special clause (30) dealing with collecting societies; deposit of rules by unregistered societies no longer allowed; annual audits required; valuation of assets and liabilities required every five years; public auditors and valuers to be appointed by the treasury, but their employment not compulsory; the number of members who can apply to the registrar for an award of dissolution reduced; further powers given to the registrar on this point. Alterations in friendly society law subsequent to 1876 have been unimportant, and generally introduced 'to declare the true meaning' of some clause in the Act of 1875. Note, however, should be made of 50 and 51 Vict. chap. 56, which empowers juvenile societies and branches to retain membership till the age of twenty-one years, the former limit being sixteen years. Societies and branches consisting wholly of members between three and twenty-one years of age may be registered, provided (1) they are in connection with some adult society registered under the act, or a branch of any such society, or (2) in connection with some institution or school.

Owing to technical legal difficulties, the registry office is unable to supply accurate information as to the present numerical and financial strength of the friendly society position; but the writer, from returns specially made to him, is in a position to give the following estimate (which will be found approximately correct) of the principal types of society, registered and unregistered:

	No. of Members.	Funds.
(1) Affiliated Societies	2,024,000	£13,103,000
(2) General with County Societies	300,000	1,500,000
(3) Peculiar Trade Societies—		
(*a*) Railway Group	57,000	144,000
(*b*) Miners' Permanent Relief Funds	230,000	253,000
(4) Local Societies, inclusive of Dividing Clubs	1,000,000	2,000,000
(5) Collecting Societies	3,590,000	2,286,000
(6) Societies of Women	10,000	
(7) Juvenile Societies	200,000	190,000
Total	7,411,000	£19,476,000

(1) The affiliated societies are broadly distinguished from their competitors for public favour by being before all things 'friendly' fraternities, in which the social element is the motor of action—sick and burial clubs, and something more. Long ago this type of society crossed the seas and accompanied the emigrant to his new home in 'Greater Britain.' In constitution and government the orders, as they are termed, are pure democracies. First comes the individual branch—lodge, court, tent, or senate—possessing an independence of management (subject only to general law), and retaining its own sick fund. Then succeeds the district (the limbs, as it were, of the body), a local gathering of branches within a certain given area, in which the funeral allowance is reinsured; and, lastly, the central body itself, called by some distinctive name (as Annual Movable Committee, High Court Meeting), an annually or biennially elected parliament of delegates, carrying out its rules and regulations through a working executive. The far and away largest bodies are the Oddfellows (Manchester Unity) and the Ancient Order of Foresters, appropriating between them 1,313,721 members out of the grand total for the class and £10,495,000 of the funds. Other important orders are United Order of Oddfellows (150,806), Temperance Order of Rechabites (75,000), Ashton Unity of Shepherds—the strongest order in Scotland—(71,000), and Order of Druids (58,216). The average cost of management is 7 per cent. of the annual contributions. (2) Is a development of the purely local class to meet the altered needs of the day. The class consists of societies of divers degrees of merit, a common central fund. The the Hearts of Oak (London), with its 115,284 members and capital of close on one million sterling. The county societies are the 'old established houses' belonging to the 'patronised' group, and are being deserted for the better known of the orders. (3) This class is specially devoted to insurance against the fatal and non-fatal accidents of hazardous occupations, and is of interest as being largely used by workmen to contract themselves out of the Employers' Liability Act (1880). There has been a recent development of peculiar trade societies, and certain of the professions have established benefit institutions—e.g. Medical Sickness and Annuity, and Clergy Friendly Societies, the former possessing a membership of over 1000 and funds to the value of nearly £25,000. (4) Local societies are fast disappearing before the onward march of a better class of mutual provident association. But the low type of friendly society which periodically divides its funds, and is always beginning afresh to run in the thrift race, is sadly too prevalent; the increasing liability to sickness with advancing years is altogether ignored; a blind eye is turned on the future. (5) Societies which gather in their weekly or fortnightly pence by means of collectors calling from door to door. The bulk of membership is composed of the most necessitous poor, and probably two-thirds are women or children. No benefit beyond an insurance at death is given. The actual number of societies forming the class is a small one compared with the total number; for England only 47 out of about 24,000 different bodies registered as societies or branches; in Scotland 5 out of 900; in Ireland none out of some 400. The largest societies are the Royal Liver (1,211,259) and the Liverpool Victoria Legal (1,003,787). The expenses of management, with commissions, range from 20 to 52 per cent. of the annual premiums. The numerical increase of the class is only surpassed by that of the Industrial Assurance Companies. (6) Societies of women are but poorly represented in the voluntary thrift army, and the few that exist were mostly established in an unfinancial age. An order which aims to be national in its area of membership was, however, established in 1885 by a clergyman of the Church of England (Rev. J. Frome Wilkinson), which has already opened branches in several counties (one in Scotland), and should meet the ever-increasing economic needs of women. The society is registered as the United Sisters' Friendly Society (Suffolk Unity). (7) Juvenile societies are the thrift 'nurseries' of the adult societies, and are mostly confined to the affiliated class, the largest number of branches being in connection with the Foresters, Manchester Unity, and Rechabites. There is a steady increase in the popularity of juvenile friendly society membership.

Tests of Financial Security and Good Management.—Registration, 'not because registry of itself can make any society safe, but because its position must be always unsafe without registry.' Rates of contribution for benefits, both sick and funeral, on a graduated or sliding scale, according to age on entry, which rates themselves shall be held by actuarial authority sufficient to carry benefits contracted for. Record of yearly sickness and mortality experience kept, so that the valuer may be in possession of sufficient data by which to estimate the society's or branches' liabilities. Yearly audit and five-yearly financial overhaul or efficient valuation of assets and liabilities. Effect given, without undue delay, to remedial measures recommended by valuer, should liabilities exceed assets. The several insurance funds kept separate, and

expenses of management provided for. Sick benefits insured till sixty-five, at which age a pension or deferred annuity shall commence, and continue for remainder of life. Reserve funds to realise a clear percentage of interest, equal to that on which tables or scales of contributions have been calculated, generally 3 per cent. Candidates refused who cannot 'pass' the doctor, or who have exceeded in years the maximum limit of forty-five, forty being preferred. Efficient supervision of sick payments to guard against 'malingering' or fictitious claims. Society not to be of local isolated type, dependent solely on its own resources, but associated with other branches of one and the same organisation, or of the centralised type. Means to be taken, in seasons of distress or loss of work, whereby membership may be retained. Provision, if desired, for juveniles, widows, orphans, and decayed members.

We would strongly endorse the subjoined authoritative warning: 'A word of caution may be added against forming too hasty conclusions adverse to friendly societies, if it should turn out that the valuations in many cases show an estimated deficiency in the funds to meet the liabilities. It would be strange if it were otherwise, when for the first time scientific tests are applied to contracts that have been in operation without a scientific basis for a long series of years. It must be borne in mind, however, that nothing is more elastic than the contract made by a friendly society with its members; no error more easy of remedy, if found out in time, than one existing in the original terms of such a contract. Hence the words "insolvency," "rottenness," and the like, which we sometimes hear freely used as describing the general condition of friendly societies, are utterly out of place. Of friendly societies in general it may be said that, as there are no associations the benefits of which are more important to their members, so there are none that are managed with greater rectitude, and few with equal success.' —Introduction to W. Tidd Pratt's *Law of Friendly Societies* (1881), by E. W. Brabrook, F.S.A.

For further information, the following authorities may be consulted: Dr Baernreither's *English Associations of Working Men* (Lond. 1889); Wilkinson's *Friendly Society Movement* (Lond. 1886); *Year Book of Friendly Societies Registry Office;* Annual Reports of Chief Registrar. Also Ratcliffe's *Experience of the Manchester Unity;* Mr Francis G. P. Neison's *Foresters' Experience;* and the same eminent actuary's *Observations on the Efficient Valuation of Friendly Societies.*

Friends, SOCIETY OF, the designation proper of a sect of Christians, better known as Quakers. Their founder in 1648–66 was George Fox (q.v.). In spite of severe and cruel persecutions, the Society of Friends succeeded in establishing themselves both in England and America. They have, indeed, never been numerically powerful (having at no time exceeded 200,000 members); but the purity of life which from the beginning has so honourably distinguished them as a class has unquestionably exercised a salutary influence on the public at large; while in respect of certain great questions affecting the interests of mankind, such as *war* and *slavery*, they have, beyond all doubt, originated opinions and tendencies which, whether sound or erroneous, are no longer confined to themselves, but have widely leavened the mind of Christendom. Eminent Friends have been George Fox, Robert Barclay, Thomas Ellwood, William Penn, Elizabeth Fry, J. J. Gurney, Bernard Barton, John Bright, &c.; an 'unfriendly' Friend was George Robins, who revolutionised the art of Gunnery (q.v.). We confine ourselves to a brief notice of their doctrine, practice, and discipline, as laid down in their own publications.

(1) *Doctrine.*—It is perhaps more in the spirit than in the letter of their faith that the Society of Friends differ from other orthodox Christians. They themselves assert their belief in the great fundamental facts of Christianity, and even in the substantial identity of most of the doctrinal opinions which they hold with those of other evangelical denominations. The Epistle addressed by George Fox and other Friends to the governor of Barbadoes in 1673 contains a confession of faith not differing materially from the so-called Apostles' Creed, except that it is more copiously worded and dwells with great diffuseness on the internal work of Christ. The Declaration of Christian Doctrine put forth on behalf of the Society in 1693 expresses a belief in what is usually termed the Trinity, in the atonement made by Christ for sin, in the resurrection from the dead, and in the doctrine of a final and eternal judgment; and the Declaratory Minute of the yearly meeting in 1829 asserts the inspiration and divine authority of the Old and New Testament, the depravity of human nature consequent on the fall of Adam, and other characteristic doctrines of Christian orthodoxy, adding: 'Our religious Society, from its earliest establishment to the present day, has received these most important doctrines of Holy Scripture in their plain and obvious acceptation.' It is nevertheless certain that uniformity of theological opinion cannot be claimed for the Friends, any more than for other bodies of Christians. As early as 1668 William Penn and George Whitehead held a public discussion with a clergyman of the English Church, named Vincent, in which they maintained that the doctrine of a tri-personal God, as held by that church, was not found in the Scriptures, though in what form they accepted the doctrine themselves does not appear; and some time later Penn published a work himself, entitled the *Sandy Foundation Shaken*, in which, among other things, he endeavoured to show that the doctrines of vicarious atonement and of imputed righteousness do not rest on any scriptural foundation. But in general the Society of Friends, in the expression of their belief, have avoided the technical phraseology of other Christian churches, restricting themselves with commendable modesty to the words of Scripture itself, as far as that is possible, and avoiding, in particular, the knotty points of Calvinistic divinity (see Barclay's *Catechism and Confession of Faith*, published in 1673, where the answers to the questions—to avoid theological dogmatism—are taken from the Bible itself). This habit of allowing to each individual the full freedom of the Scriptures has, of course, rendered it all the more difficult to ascertain to what extent individual minds, among the Society, may have differed in their mode of apprehending and dogmatically explaining the facts of Christianity. Their principal distinguishing doctrine is that of the 'Light of Christ in man,' on which many of their outward peculiarities, as a religious body, are grounded. The doctrine of the internal light is founded on the view of Christ given by St John, who, in the first chapter of his gospel, describes Christ—the Eternal Logos—as the 'life' and 'light of men,' 'the true light,' 'the light that lighteth every man that cometh into the world,' &c. Barclay taught that even the heathen were illumined by this light, though they might not know—as, indeed, those who lived before Christ *could* not know—the historical Jesus in whom Christians believe. In their case Christ was the light shining in darkness, though the darkness comprehended it not. The existence of 'natural virtue' (as orthodox theologians term it) among the heathen was denied by Barclay, who regarded all such virtue as Christian in its essence, and as proceeding from the light of Christ shining through

the darkness of pagan superstition. These opinions would seem to be somewhat freer than those expressed in the General Epistle of the Society published in 1836, wherein they refuse to acknowledge 'any principle of spiritual light, life, or holiness inherent by nature in the mind of man,' and again assert that they 'believe in no principle whatsoever of spiritual light, life, or holiness, except the influence of the Holy Spirit of God bestowed on mankind in various measures and degrees through Jesus Christ our Lord.' But, on the other hand, in a little treatise published by the Society in 1861 it is affirmed that 'the Holy Spirit has always been afforded in various measures to mankind;' while stress is also laid on the statement of St Paul, that 'the grace of God (understood by Friends to signify the 'operation of the Divine Spirit') that bringeth salvation *hath appeared to all men*.' And another exponent of their views, Mr T. Evans, of Philadelphia, states that 'God hath granted to all men, of whatsoever nation or country, a day or time of visitation, during which it is possible for them to partake of the benefits of Christ's death, and be saved. For this end he hath communicated to every man a measure of the light of his own Son, a measure of grace or the Holy Spirit, by which he invites, calls, exhorts, and strives with every man, in order to save him; which light or grace, as it is received, and not resisted, works the salvation of all, even of those who are ignorant of Adam's fall, and of the death and sufferings of Christ, both by bringing them to a sense of their own misery, and to be sharers in the sufferings of Christ inwardly, and by making them partakers of his resurrection, in becoming holy, pure, and righteous, and recovered out of their sins.' Hence it may be safely asserted that they hold a broader (or, as others would say, a more latitudinarian) view of the Spirit's working than any other Christian church or society. In America, about the year 1827, Elias Hicks, a Friend of very remarkable powers, created a schism in the Society, by the promulgation of opinions denying the miraculous conception, divinity, and atonement of Christ, and also the authenticity and divine authority of the Holy Scriptures. About one-half of the Society in America adopted the views of Hicks, and are known as Hicksite Friends; their opinions, of course, are repudiated by the rest of the Society, who may be described as Orthodox Friends. The Hicksite schism thoroughly alarmed the latter, both in England and America, and a movement was begun in favour of education, of a doctrinal belief more nearly allied to that of the so-called 'Evangelical' party, and of a relaxation in the formality and discipline of the Society. The leader of this movement was Joseph John Gurney, of Norwich. This new tendency, however, excited considerable opposition among some of the Friends in America; and the consequence was a division among the Orthodox Friends themselves, and the formation of a new sect, called 'Wilburites,' after the name of their founder, John Wilbur, who are noted for the strictness with which they maintain the traditions and peculiarities of the Society. Some slight indications of theological differences have manifested themselves in England also.

(2) *Practice.*—It is in the application of their leading doctrine of the 'internal light' that the peculiarities of the Friends are most apparent. Believing that it is the Holy Spirit, or the indwelling Christ, that alone maketh wise unto salvation, illumining the mind with true and spiritual knowledge of the deep things of God, they do not consider 'human learning' essential to a minister of the gospel, and look with distrust on the method adopted by other churches for obtaining such—viz. by formally training after a human fashion a body of youths chosen on no principle of inward fitness. They believe that the call to this work now, as of old, is 'not of men, neither by man, but by Jesus Christ and God the Father,' and that it is bestowed irrespectively of rank, talent, learning, or sex. Consequently, they have no theological halls, professors of divinity, or classes for 'students.' Further, as fitness for the ministry is held to be a free gift of God through the Holy Spirit, so, they argue, it ought to be freely bestowed, in support of which they adduce the precept of the Saviour—'Freely ye have received, freely give;' hence those who minister among them are not paid for their labour of love, but, on the other hand, whenever such are engaged from home in the work of the gospel, they are, in the spirit of Christian love, freely entertained, and have all their wants supplied: in short, the Friends maintain the absolutely voluntary character of religious obligations, and that Christians should do all for love, and nothing for money. It also follows from their view of a call to the work of the ministry that women may exhort as well as men, for the 'spirit of Christ' may move them as powerfully as the other sex. The prophecy of Joel as applied by Peter is cited as authority for the preaching of women: 'On my servants and on my handmaidens I will pour out in those days of my Spirit, and they shall prophesy.' They also adduce the New Testament examples of Tryphæna, Tryphosa, the beloved Persis, and other women who appear to have laboured in the gospel. Their mode of conducting public worship likewise illustrates the entireness of their dependence on the 'internal light.' In other religious bodies the minister has a set *form* of worship, through which he must go, whether he feels devoutly disposed or not. This seems objectionable to the Friends, who meet and remain in silence until they believe themselves moved to speak by the Holy Ghost. Their prayers and praises are, for the most part, silent and inward. They prefer to make melody in their hearts unto God, considering such to be more spiritual than the outward service of the voice.

The doctrine of the 'internal light' has also led the Friends to reject the ordinances of Baptism and the Lord's Supper as these are observed by other Christians. They believe the Christian baptism to be a spiritual one, and not, like the Jewish and heathen baptisms, one with water; in support of which they quote, among other passages, the words of John the Baptist himself: 'I baptise you with water, but there cometh one after me who shall baptise you with the Holy Ghost and with fire.' Similarly do they regard the rite of the Eucharist. It is, say they, inward and spiritual, and consists not in any symbolic breaking of bread and drinking of wine, but in that daily communion with Christ through the Holy Spirit, and through the obedience of faith, by which the believer is nourished and strengthened. They believe that the last words of the dying Redeemer on the cross, 'It is finished,' announced the entire abolition of symbolic rites, that, under the new spiritual dispensation then introduced, the necessity for such, as a means of arriving at truth, ceased, and that their place has been abundantly supplied by the Comforter, the Holy Ghost, whose office it now is to lead and guide men into all truth. The true Christian supper, according to them, is set forth in revelation—'Behold I stand at the door and knock: if any man hear my voice and open the door, I will come in unto him, and will sup with him and he with me.' For the same reason—viz. that the teaching of the Spirit is inward and spiritual—the Friends ignore the religious observance of days and times, with the exception of the Sabbath.

The taking or administering of oaths is regarded by Friends as inconsistent with the command of

Christ, 'swear not at all,' and with the exhortation of the apostle James—'Above all things, my brethren, swear not, neither by heaven, neither by the earth, neither by any other oath: but let your yea be yea, and your nay, nay; lest ye fall into condemnation' (see AFFIRMATION). They also refused to pay tithes for the maintenance of what they hold to be a hireling ministry, believing that Christ put an end to the priesthood and ceremonial usages instituted under the Mosaic dispensation, and that he substituted none in their place. In consequence, all consistent Friends were regularly mulcted of plate, furniture, or other goods, to the value of the amount due. The conversion of tithe into *rent-charge* (see TITHES), however, has, in the opinion of many Friends, largely removed objections to the payment to this ecclesiastical demand. In regard to the civil magistracy, while they respect and honour it, as ordained of God, they are careful to warn the members of their Society against thoughtlessly incurring its responsibilities, involving as it does the administration of oaths, the issuing of orders and warrants in reference to ecclesiastical demands, the calling out of an armed force in cases of civil commotion, and other duties inconsistent with the peaceful principles of the Society. The Friends have likewise consistently protested against war in all its forms; and the Society has repeatedly advised its members against aiding and assisting in the conveyance of soldiers, their baggage, arms, ammunition, or military stores. They regard the profession of arms and fighting, not only as diametrically opposed to the general spirit of Christ, whose advent was sung by angels in these words: 'Glory to God in the highest, and on earth peace, good-will toward men;' but as positively forbidden by such precepts as—'Love your enemies, bless them that curse you, do good to them that hate you, and pray for them which despitefully use you and persecute you;' also, 'Resist not evil; but whosoever shall smite thee on thy right cheek, turn to him the other also;' and, while they acknowledge that temporary calamities may result from adopting this principle of non-resistance, they have so strong a faith in its being essentially the dictate of divine love to the Christian heart that they believe God, by his wise and omnipotent providence, could and will yet make it 'mighty to the pulling down of the strongholds of iniquity.' The world, they believe, will by-and-by confess that the peace-makers are most truly the children of God. The efforts of the Society for the emancipation of the slaves are a part of modern British history. They may most certainly lay claim to having cultivated the moral sense of their fellow-countrymen in regard to this important question. As early as 1727 they commenced to 'censure' the traffic in slaves, as a practice 'neither commendable nor allowed,' and gradually warmed in their opposition, until the whole nation felt the glow, and entered with enthusiasm on the work of abolition. In respect to what may be called minor points, the Friends are also very scrupulous; they object to 'balls, gaming-places, horse-races, and playhouses, those nurseries of debauchery and wickedness, the burden and grief of the sober part of other societies as well as of our own.' The Printed Epistle of the yearly meeting of 1854 contains a warning against indulging in music, especially what goes by the name of 'sacred music,' and denounces musical exhibitions, such as oratorios, as essentially a 'profanation'—the tendency of these things being, it is alleged, 'to withdraw the soul from that quiet, humble, and retired frame in which prayer and praise may be truly offered with the spirit and with the understanding also.' They object, besides, to 'the hurtful tendency of reading plays, romances, novels, and other pernicious books;' and the yearly meeting of 1764 'recommends to every member of our Society to discourage and suppress the same.' A similar recommendation was issued by the Society in 1851 for the benefit of 'younger Friends' in particular, who would appear to have been tasting the forbidden fruit. The Printed Epistle of the yearly meeting of 1724 likewise 'advises against imitating the vain custom of wearing or giving mourning, and all extravagant expenses about the interment of the dead,' and this advice has been repeatedly renewed. A multitude of other minute peculiarities, which it would be tedious to note in detail, distinguish the Friends from their fellow-Christians, but one or two of these may here be referred to. The Friends have from their rise, by example and precept, urged upon their members 'plainness of speech, behaviour, and apparel,' and hence, in the matters of dress and address, have arisen certain outward peculiarities by which a 'Friend' could always be distinguished. In speech they invariably make use of 'thee' and 'thou' in addressing a single person, without respect to rank, station, or authority, and in support of this they plead correct grammar and the example of Scripture.

They also felt called to cease from denoting the several months of the year and days of the week by the names usually made use of in designating them. Instead of January, February, &c., or Monday, Tuesday, &c., they adopted 'First Month, 'Second Month,' 'First Day,' 'Second Day,' &c. For their practice in this respect they asserted that the names of the days and months used by others were given to them in honour of 'heathen deities,' and this they resolutely refused to countenance. Though there is not now the same uniformity of practice throughout the body in some of the minor peculiarities, they are to a considerable extent retained and adhered to.

(3) *Discipline.*—By the term discipline the Friends understand 'all those arrangements and regulations which are instituted for the civil and religious benefit of a Christian church.' The necessity for such discipline soon began to make itself felt, and the result was the institution of certain meetings or assemblies. These are four in number: the first, the *Preparative* meetings; second, the *Monthly* meetings; third, the *Quarterly* meetings; and, fourth, the *Yearly* meetings. The first are usually composed of the members in any given place, in which there are generally two or more Friends of each sex, whose duty is to act as overseers of the meeting, taking cognisance of births, marriages, burials, removals, &c., the conduct of members, &c., and reporting thereon to the monthly meetings, to whom the executive department of the discipline is chiefly confided. The monthly meetings decide in cases of violation of discipline, and have the power of cutting off or disowning all who by their improper conduct, false doctrines, or other gross errors, bring reproach on the Society, although the accused have the right of appeal to the quarterly meetings, and from these again to the yearly, whose decisions are final. The monthly meetings are also empowered to approve and acknowledge ministers, as well as to appoint 'serious, discreet, and judicious Friends, who are not ministers, tenderly to encourage and help young ministers, and advise others, as they, in the wisdom of God, see occasion.' They also execute a variety of other important duties. The quarterly meetings are composed of several monthly meetings, and exercise a sort of general supervision over the latter, from whom they receive reports, and to whom they give such advice and decisions as they think right. The yearly meeting consists of select or representative members of the quarterly meetings. Its function is to consider generally the entire condition of the Society in all its aspects. It receives in writing

answers to questions it has previously addressed to the subordinate meetings, deliberates upon them, and legislates accordingly. To it exclusively the legislative power belongs. Though thus constituted somewhat according to Presbyterian order, yet any member of the Society may attend and take part in the proceedings.

Women have also a special sphere of discipline allotted to them: they inspect and relieve the wants of the poor of their own sex, take cognisance of proposals for marriage, deal with female delinquents privately, and under certain restrictions may even do so officially, though in the 'testimony of disownment' they have always the assistance of members of the other sex.

The Society of Friends, in the multitude of its regulations, has not forgotten the poor; charity in its narrower, as well as in its broader sense, has always been a beautiful feature of its members. The care of the poor was one of the earliest evidences [illegible] forded to the Gentiles of the character of its principles; and it is honourable to the society that a similar provision for those united to them in religious fellowship appears to have been one of the earliest occasions of their meetings for discipline. Nevertheless, in accordance with their ruling principle, that all Christian duty should be left for its fulfilment to the spontaneity of Christian love, and not performed under compulsion of any kind, 'the provision for the poor is purely voluntary;' yet their liberality is proverbial throughout Britain and America. Their number at present amounts, it is believed, to about 120,000, of whom more than 90,000 belong to the United States.

See Fox's *Journal;* Sewel's *History of the Quakers* (1722); Besse's *Sufferings of the Quakers* (1752); Gurney's *Observations on the Peculiarities of the Society of Friends* (1824); Neale's *History of the Puritans;* Rowntree's *Quakerism Past and Present* (1859); Joseph Smith's *Descriptive Catalogue of Books by Friends* (2 vols. 1867); *Book of Christian Discipline of the Society of Friends* (1883); F. Storrs Turner, *The Quakers: a Study, Historical and Critical* (1890).

Friends of the People, an association formed in 1792 in London to obtain parliamentary reform by constitutional means. Among its members were Lords Lauderdale, Kinnaird, John Russell, and Edward Fitzgerald, and such commoners as Grey, Mackintosh, Malcolm Laing, Dudley North, Erskine, Samuel Rogers, and Sheridan.

Fries, ELIAS, a Swedish botanist, was born, 15th August 1794, in the district of Femsjö in Småland, and studied at Lund, where he early taught botany. In 1834 he was called to the chair of Practical Economics at Upsala, with which in 1851 that of Botany was conjoined. Fries introduced into Sweden the morphological theory in his *Systema Orbis Vegetabilis* (1825). His *Systema Mycologicum* (3 vols. 1820–32) was long the standard work on the classification of fungi, of which he gave a relatively complete catalogue in *Summa Vegetabilium Scandinaviæ* (2 vols. Stockholm, 1846–49). He wrote a series of useful books on the Hymenomycetæ, on lichens, and on the flora of Scandinavia, more particularly of Sweden. Among his monographs the *Symbolæ ad Historiam Hieraciorum* (Upsala, 1848) deserves especial mention. In 1851 Fries was appointed director of the botanical museum and garden at Upsala, and in 1853 rector of the university. He resigned in 1857, and died there, 8th February 1878.

Fries, JAKOB FRIEDRICH, the founder of a philosophic school in Germany, was born at Barby, in Prussian Saxony, 23d August 1773, studied at Leipzig and Jena, and in 1805 was called to Heidelberg as professor of Philosophy and Mathematics. In 1816 he accepted a call to the chair of Speculative Philosophy at Jena, but was deprived of his professorship on account of his participation in the democratic disturbances of 1819. In 1824, however, he was appointed to the chair of Physics and Mathematics, which he occupied till his death, 10th August 1843. Amongst his more important books are *System der Philosophie* (1804); *Neue Kritik der Vernunft* (3 vols. 1807); *System der Logik* (1811); *Handbuch der psychischen Anthropologie* (1820–21); *Die Lehren der Liebe, des Glaubens, und der Hoffnung* (1823); and *Geschichte der Philosophie* (1837–40). Taking the Kantian philosophy for his starting-point, Fries demonstrated that intuitive psychology must be the basis of all philosophising. Thus, through inner experience *a posteriori* we learn to know the subjective *a priori* conditions of knowledge; and through intuitive presentiment or faith we derive our certainty of the reality of things themselves. From inner assurance of the essential worth and personal dignity of men flow the definitions and sanctions of ethics, and from the same source originate our æsthetic and religious feelings. See Henke, *J. F. Fries* (1867).

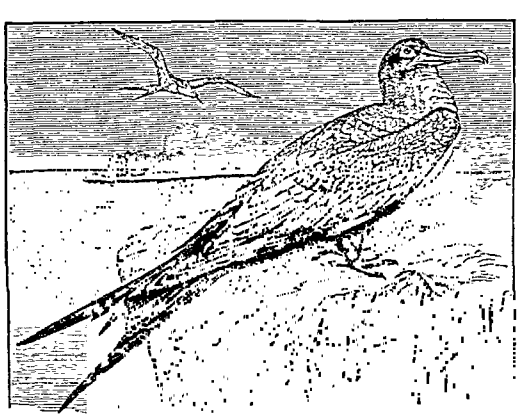
Friesland, or VRIESLAND (ancient *Frisia*), in its widest sense, as the country of the Frisian race, included the modern provinces of Zealand, North and South Holland, part of Utrecht, Friesland proper, and Groningen in Holland, together with Prussian East Friesland and a part of Oldenburg, the western coast of Sleswick between the Eider and the Tondern, and the islands of Sylt, Föhr, Nordstrand, and others. The province of Friesland proper in the Netherlands is bounded N. by the German Ocean and W. and SW. by the Zuider Zee. It is sometimes called West Friesland to distinguish it from East Friesland. Area, 1282 sq. m.; pop. (1875) 311,246; (1885) 330,866. The land is flat, in some parts below the level of the sea, and is cut up by canals and streams. The lowlands are protected by artificial banks or dykes. Lakes and marshes are numerous. The dykes, sluices, and canals are under the care of a special board, and are kept up at the local expense. The inland and sea waters abound with fish. Rich pastures cover a third part of the surface. The horses, cattle, and sheep are all of excellent breeds. Large quantities of peat are dug. The capital is Leeuwarden, and the chief port Harlingen, whence are shipped cheese and butter (mostly to London), horses, cattle, leather, and wool. The climate is moist and misty, but not raw. The inhabitants, who are descended from the ancient Frisians, speak a peculiar dialect. The industries are unimportant. —East Friesland, with an area of 1200 sq. m., and a pop. amounting (1885) to 211,825, formerly a principality of Westphalia, now forms the Hanoverian district of Aurich; chief towns, Emden and Aurich. It is bounded N. by the German Ocean and W. by the Netherlands. Like West Friesland it is low and flat. With the help of the Prussian government the moors are being reclaimed and cultivated. Fishing and agriculture constitute the chief employment of the inhabitants, who are Frisians. This province has frequently changed owners since 1744, when the family of Cirksena, in whose possession it had been for 300 years, became extinct. It was first ceded to Prussia, next incorporated by Napoleon with Holland and France; in 1813 it was restored to Prussia; in 1815 it was ceded to Hanover, along with which it again forms part of Prussia. See FRISIANS, and H. M. Doughty's *Friesland Meres* (1889).

Frieze, in classical architecture, the central portion of the Entablature (q.v.). Vitruvius also

calls it the Zophorus ('life-bearing') from its being frequently ornamented with sculpture. Similarly, the term frieze is sometimes applied to any enriched horizontal band.

Frigate (Fr. *frégate*, Ital. *fregata*), formerly a long, narrow vessel propelled by oars and sails, used in the Mediterranean on occasions when speed was requisite. The name then came to be applied to men-of-war, of a class smaller than line-of-battle ships, and carrying from twenty to fifty guns, which were distributed on the main and upper decks. They were employed in the great wars of the 18th and early part of the 19th centuries, as scouts and cruisers. The frigate was usually swift, easily managed, and capable of beating well to windward. She became, therefore, the favourite ship in war-time, and bore off a large proportion of the prize-money. Frigates also served to obtain information as to the movements of hostile fleets, and to guide the sailing of their own; but it was unusual for them to join in the line of battle, their exploits ordinarily occurring in engagements with single ships of their own class. With steam and the growth of the royal navy in later times frigates were developed more than any other men-of-war, and many of the largest ships in the navy belonged to this class, such as the iron-plated *Warrior*, of 6000 tons, three times the burden of any ship of the line in Nelson's fleets. Now, however, these are all ships of the past, incapable of contending with the turreted monsters which carry modern artillery, and the name frigate itself has disappeared from the *Navy List*, the term 'cruiser'—armoured or unarmoured—having taken its place. This is true also of the United States navy.

Frigate Bird, or MAN-OF-WAR BIRD (*Tachypetes aquila*), a tropical marine bird, placed near pelicans and cormorants in the order Steganopodes. In flight it is extremely powerful, and makes use of its swiftness and strength to force other birds to surrender their prey. The food consists of fish, which, if not stolen, are caught at the surface. Flying-fish are said to form an important constituent of its diet. It may be seen out at sea 100 miles from land, but nests and breeds on the coasts of the tropical Atlantic and Pacific—e.g. off Honduras, where vast 'rookeries' have been described. The bird is large, measuring about 4 feet in length, with very long wings and tail.



Frigate Bird (*Tachypetes aquila*).

The beak is hooked, and almost twice as long as the head. The prevalent colour is brownish-black; the female has a white breast, and, like the young birds, differs in minor points from the adult male. In some parts it is said to become half-tame, and even to be available for letter-carrying.

Frigga, in northern mythology, the wife of Odin, who seems to have occupied an analogous position to that of Venus in Roman mythology. She was also the goddess of the earth and of marriage, and was frequently confounded, and latterly quite identified, with Freyja (q.v.). She was the only Scandinavian deity placed amongst the stars; Orion's belt is called in Swedish Frigga's distaff. From her Friday takes its name.

Frilled Lizard. See CHLAMYDOSAURUS.

Fringe Tree (*Chionanthus*), a genus of Oleaceæ, of which the common species or Fringe Tree or Snowflower (*C. virginica*), found in the United States from 39° lat. to the Gulf of Mexico, is a large shrub with very numerous snow-white flowers in panicled racemes. The limb of the corolla is divided into four long linear segments, whence the name fringe tree. The fruit is an oval drupe. The tree is frequently cultivated as an ornamental plant. The root bark is narcotic.

Fringillidæ. See FINCH.

Frisches Haff ('Fresh-water Bay'), a lagoon on the coast of Prussia, south-east of the Gulf of Danzig, about 50 miles in length, 4 to 11 miles broad, and 332 sq. m. in area. It was once entirely walled off from the Baltic by a narrow spit of land, through which a passage, 1247 feet wide and 14½ feet deep, was cut in 1510 during a violent storm. The Haff is 10 to 16 feet deep.

Frisians, a people of Teutonic stock, who, Tacitus says, when the Romans first came into contact with them, occupied the maritime region extending from the Scheldt to the Ems and Weser. They submitted to the Roman power in the reign of Drusus, and were loyal and helpful tributaries until stung into revolt in 28 A.D. by the extortions of a Roman provincial officer. From that time onwards they rendered only sullen submission to the empire, and more than once revolted and maintained their independence for some years. They were sea-rovers, as well as herdsmen and husbandmen, and took part along with the Angles and Saxons in the conquest of Britain. We next read of them as offering a stubborn resistance not only to the introduction of Christianity, but also to the encroachments of the Frankish power from the south; in fact, in spite of the efforts of Wilfrid of York, the first missionary among the Frisians, and his successors Willibrord and Boniface, the Christian religion does not seem to have obtained footing in Frisia beyond the actual limits of Frankish dominion until the complete absorption of the Frisians' land in the empire of Charlemagne. In the meantime they had waged an almost continuous war against the Franks. Their king Radbod, although driven out of western Frisia (from the Scheldt to the Zuider Zee) in 689 by Pepin, so far turned the tables after the death of this king that he sailed up the Rhine to Cologne, and defeated Charles Martel, in 716. Their last independent prince, Poppo, was defeated and slain by Charles Martel in 734, and the conquest of the Frisians was completed by Charlemagne. At the partition of the Frankish empire made at Verdun in 843 Frisia became part of Lotharingia or Lorraine. In 911, however, when Lotharingia seceded from the eastern to join the western Frankish empire, the districts of eastern Frisia (from the Zuider Zee to the Weser) asserted their independence, and formed themselves into a sort of democratic confederated republic, until in the first half of the 15th century they became virtually a countship, being ruled by the dynasty of the Cirksena down to the extinction of the family in 1744, when Prussia took possession of it. Meanwhile the western half of Frisia had for the most part been absorbed in the bishopric of Utrecht and the

countship of Holland, though not without a most stubborn resistance on the part of the Frisians, a resistance which had not wholly died out by the end of the 15th century. In fact in 1457 the Emperor Frederick III. recognised their immediate dependence upon the empire. And it was only in 1498 that their staunch love of liberty was finally crushed by Albert of Saxony, whom Maximilian had appointed hereditary imperial governor of Frisia. From 1523, when the governorship fell to Charles V., Frisia became virtually a part of the Netherlands, and from that time onwards shared their destiny.

The Frisian language is a member of the Low German family, coming intermediate between Old Saxon and Anglo-Saxon. Its most striking peculiarity is the modification of *k* and *g* into *ts* before the letters *e* and *i*. The oldest existing specimens of the language do not go back beyond the 14th and 15th centuries, and consist principally of the old law codes and similar official documents (collected in Richthofen, *Friesische Rechtsquellen*, 1840). The celebrated *Lex Frisionum*, although it belongs probably to the period of Charlemagne, is composed in Latin, and contains a very meagre sprinkling of Frisian terms. At the present day pure Frisian is spoken only by the peasantry in the west of Dutch Friesland and in one or two isolated districts of Prussian East Friesland, and is cultivated by a small coterie of men of literary taste in Holland. Corrupt forms are spoken in Heligoland and in parts of Jutland and Sleswick. Gysbert Japicx occupies the first place amongst Frisian writers, having published in 1668 a volume of poems entitled *Friesche Rijmlerye*. Other books held in great esteem by the Frisians are a comedy, *Waatze Gribberts Brilloft*, dating from the beginning of the 18th century, and the popular work, *It Libben fen Aagtje Ijsbrants (1827)*. *Het Oera Linda Bok*, of which an English edition appeared in 1877, though purporting to be of vast antiquity, was really written by a ship-carpenter, Over de Linden (1811–73). Besides these, quite modern works have been written by E. and J. H. Halbertsma, Salverda, Posthumus, Windsma, Dykstra, Deketh, Van der Veen, Van Assen, and others. The most important production in northern Frisian, the corrupt dialect of Jutland and Sleswick, is Hansen's comedy *De Gidtshals*. A society was founded at Franeker in 1829 for the study of the Frisian language and history.

The most complete accounts of Frisian literature are perhaps to be found in Mone, *Uebersicht der niederländischen Volkslitteratur älterer Zeit* (1838), and Winkler, *Allgemeen nederduitsch en friesch Dialecticon* (1872). For the study of the language, see grammars by Rask, Grimm, Heyne, and A. H. Cummins (2d ed. Lond. 1888), grammars, dictionaries, &c. by Richthofen (1840), J. Halbertsma (1874), Cadovius Müller (died 1725), Ten Doornkaat-Koolman (1877–85), Dirksen (1889), Outzen (1837), Bendsen (1860), and Johansen (1862).

Frit (*Chlorops frit*), a small black Dipterous corn-fly, common in North Europe, not known in Britain, doing great damage especially to barley (see CORN INSECTS).

Frith. See FIRTH.

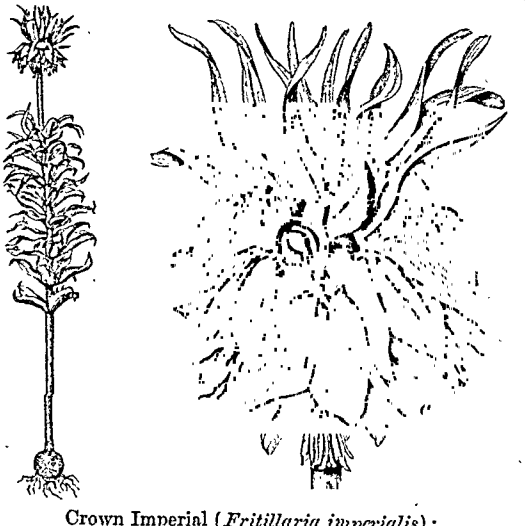
Frith, JOHN, reformer, was born about 1503 at Westerham, Kent, and from Eton passed to King's College, Cambridge, whence in 1525 Wolsey summoned him to his new foundation at Oxford. A twelvemonth later, however, suspicion of heresy drove him a fugitive to the young Protestant university of Marburg, and during his five years' stay here he saw much of Tyndale and Patrick Hamilton, and wrote several Protestant treatises. Venturing back to England in 1532, he was seized and lodged in the Tower, and on 4th July 1533 was burned at Smithfield. He has been called the author of the Anglican doctrine of the Eucharist.

Frith, WILLIAM POWELL, R.A., was born at Aldfield, Yorkshire, on the 9th January 1819. He studied art at Sass's Academy, London, and in the schools of the Royal Academy; and in 1840 exhibited his 'Othello and Desdemona' in the British Institution. He painted portraits, and his early subject-pictures were scenes from the English and French classics. His 'Coming of Age in the Olden Time' first brought its painter into notice, and his celebrity was increased by 'Ramsgate Sands' (1854); 'The Derby Day' (1858); and 'The Railway Station' (1862). His later works include 'Charles II.'s Last Sunday' (1867); 'Before Dinner at Boswell's Lodgings' (1868), which in 1875 sold for £4567; the gambling subjects entitled 'The Road to Ruin' (1878); and 'A Private View, a Scene at the Royal Academy' (1883). His productions, while destitute of the finer artistic qualities, have been extremely popular on account of the interest of their subjects and their obvious dramatic point, and have become widely known by means of engravings. He was elected A.R.A. in 1846, and R.A. in 1852; and his pleasant *Autobiography and Reminiscences* (3 vols.) was published 1887–88.

Common Fritillary (*Fritillaria meleagris*).

Frithjof's Saga. See ICELAND and TEGNER.

Fritilla'ry (*Fritillaria*), a genus of Liliaceæ, closely allied to the lily and tulip, herbaceous, bulbous-rooted, with bell-shaped perianth of six distinct segments, each having a conspicuous circular nectary at the base. About twenty species are known, all palæarctic. All of them have drooping flowers; some of them are



Crown Imperial (*Fritillaria imperialis*): *a*, flower enlarged.

beautiful. One species only is a native of Britain, the Common Fritillary (*F. meleagris*), also called Snake's Head, Chequer-flower, &c., which is found in meadows and pastures in the east and south of England, flowering in April or May. They are specially plentiful in the Magdalen water-meadows, Oxford. The flowers are pale or dark purple, tesselated with dark markings, sometimes cream-white. Many varieties are in cultivation.—This genus includes the Crown Imperial (*F. imperialis*), which was brought from Persia to Constantinople in the 16th century, and thence introduced through the imperial garden at Vienna into western Europe, where it soon became a constant inmate of the herbaceous border. The bulb of the common species, but still more of this one, is poisonous.

Fritillary, a name given to a number of butterflies (Argynnis, Melitæa, &c.), some of which are common in Britain, from the resemblance of the colouring on the upper surface of their wings to that of the flowers of the common fritillary.

Friuli (Ger. *Friaul*, Lat. *Forum Julii*), the name of a district formerly governed by independent dukes, lying at the head of the Gulf of Venice. With a total population of about 700,000, and a total area of some 3470 sq. m., it is divided between Austrian Friuli, embracing the districts of Görz, Gradisca, and Idria, and Italian Friuli, including the province of Udine and the district of Portogruaro. Friuli is rich in corn and wine, and has much metallic wealth and numerous mineral springs. The inhabitants, called *Furlani*, are mostly Italians, some of them speaking a peculiar dialect containing several Celtic elements. Friuli constituted one of the thirty-six duchies into which the Lombards divided the north of Italy, and shared the vicissitudes of its neighbour states.

Frobenius, JOANNES, the learned printer, was born in Franconia in 1460, founded a printing-office at Basel in 1491, and published a Latin Bible, editions of Cyprian, Tertullian, Hilary, Ambrose, and the Greek New Testament (1496). As correctors to the press he employed such men as Œcolampadius and Erasmus; and between 1491 and 1527, the year of his death, he issued 300 works (including all those of Erasmus), well printed and wonderfully free of error.

Frobisher, SIR MARTIN, one of the great Elizabethan seamen, was born in Yorkshire, either at Altofts (near Wakefield) or at Doncaster about 1535. Sent to sea as a boy, he traded to Guinea and elsewhere, and seems at an early age to have become possessed by his life-long dream of a north-west passage to Cathay. After long solicitations he was enabled, chiefly by help of Warwick, to set sail northwards round the Shetland Islands, 7th June 1576, with the *Gabriel* and the *Michael* of 20 tons each and a pinnace of 10 tons, with a total complement of thirty-five men. The pinnace was soon lost in the storms that followed, and the *Michael* deserted, but Frobisher held on his adventurous course, was almost lost on the coast of Greenland, and reached Labrador on the 28th July. From Hall's Island at the mouth of Frobisher Bay his men carried away some 'black earth,' which was supposed in London, whither he arrived on October 9th, to contain gold. Next year a new expedition was fitted out with much enthusiasm, the queen herself supplying from the royal navy a vessel of 200 tons. The country around Hall's Island was formally taken and named *Meta Incognita*, and abundance of the black earth was brought to England. Yet another and well-appointed expedition was despatched in 1578, but was harassed by storms without and dissensions within, and returned home with a great cargo of the ore, from which, however, no more gold could be extracted. Of Frobisher we hear but little during the next few years, but in 1585 he commanded a vessel in Drake's expedition to the West Indies, did good service in the preparatory task of hampering the designs of Spain, and in the struggle with the Armada covered himself with glory by his conduct in the *Triumph*, and was rewarded by the honour of knighthood. Frobisher next married a daughter of Lord Wentworth, and settled down as a country gentleman, but was soon again at the more congenial task of scouring the seas for the treasure-ships of Spain. At the siege of Crozon near Brest in the November of 1594 he received a wound of which he died at Plymouth on the 22d of the same month. His *Three Voyages* were edited by Admiral Collinson for the Hakluyt Society (1867). There is a Life by Rev. F. Jones (1878).

Frobisher Bay, an inlet opening westward near the mouth of Davis Strait into the territory called by Frobisher *Meta Incognita*, at the southern end of Baffin Land. It is about 200 miles long by above 20 wide, with rugged mountainous shores. It was till Hall's voyage called Frobisher *Strait*, being erroneously regarded as a passage into Hudson Bay.

Froebel, FRIEDRICH WILHELM AUGUST, German educational reformer, was born at Oberweissbach in Thuringia, 21st April 1782. His studies at Jena being interrupted by the death of his father in 1802, he was compelled to shift as best he could for a living, until in 1805, at Frankfort-on-the-Main, he found his true vocation in teaching. The next five years he spent partly at Frankfort, partly at Yverdon in Switzerland, at the latter place in close intimacy with Pestalozzi. Then for a couple of years he resumed his studies, this time chiefly in the natural sciences, at Göttingen and Berlin. But again they were interrupted: the War of Liberation broke out, and Froebel joined Lützow's corps. Two years after the conclusion of peace he got his first opportunity to realise his long-meditated principles of education; he made a start at Griesheim in Thuringia, but in the following year (1817) transferred his school to Keilhau, where he was shortly afterwards joined by his devoted friends and disciples, Langethal and Middendorff. At this time the characteristic idea of his teaching was that the root of all educational development is action, which has for its ultimate aim not only mere physical exercise, but also the unfolding and strengthening of the mental powers; and underlying this was the conviction that the real purpose of education should be to encourage the child to grow naturally and spontaneously, unfolding all its powers according to the inner organic laws of its being, just as grow plants and animals and crystals. In 1826 he expounded his views in a work entitled *Die Menschenerziehung*. With the view of extending his system, Froebel in 1831 established a branch institution in the canton of Lucerne in Switzerland, which, however, could never make headway against the opposition of the Roman Catholic clergy. Hence, after starting an orphanage at Burgdorf in Bern, where also he began to train teachers for educational work, Froebel returned to the centre of Germany, and in 1836 opened at Blankenburg, not far from Keilhau, his first Kindergarten (q.v.) school. The rest of his life was spent in the advocacy of kindergarten schools and in organising them; but along with these labours he combined the training of teachers to carry on the system he had devised. He died on 21st June 1852 at Marienthal in Thuringia. Froebel's works were collected and published by Wichard Lange in 1862–63 (new ed. 1874), also by Seidel in 1883. See *Autobiography of F. Fröbel*

(Lond. 1886); *Life of Froebel*, by Emily Shirreff (Lond. 1887); and his *Letters*, translated by Moore and Michaelis (1890).

Frog, a genus (Rana) of tailless Amphibians; but the name, usually with some prefix or other, is often extended to the members of related genera or even of related families—e.g. to the obstetric frog (Alytes), to the tree-frogs (Hylidæ), or to the peeping frogs (Hylodes). The common frog in Britain is *Rana temporaria*, distinguished from the edible frog, *R. esculenta*, which has been introduced into Britain, by slight differences in colouring, by the presence of a dark, triangular patch extending backwards from the eye, and by the absence of the dilatable sacs (at the back corners of the mouth) which intensify the croaking of the 'Cambridgeshire Nightingales.' The general shape is an elongated oval, of which the head occupies about a third; a hump on the back marks the end of the distinct vertebræ and the beginning of an unsegmented portion known as the urostyle. The tail has completely disappeared, the young animal having literally lived upon it during part of its

Common Frog (*Rana temporaria*).

metamorphosis. The arms are short, the fingers four and unwebbed, and the innermost is swollen in the males; the hind-legs are long and muscular, well adapted for both leaping and swimming, with an elongated ankle, five webbed toes, and an internal 'tarsal tubercle' like a hint of a sixth. The skin is soft and glandular, with pigment cells admitting by their changes of a slight alteration in colour. The external nostrils are situated near the tip of the snout; the eyes have a movable lower lid; the tympanum or drum of the ear is readily seen somewhat farther back.

General Life.—The frog, aquatic in its youth, generally remains near water. In dry weather it hides itself, and great numbers are often seen to issue forth on the welcome return of rain. Their leaping and swimming deftness need no remark. The adults feed upon living animals, insects, and slugs. These are caught on the large viscid tongue, which being fixed in front of the mouth and free behind, can be thrown rapidly outwards, and even more rapidly retracted. In winter the frog 'hibernates' or lies torpid, buried in the mud at the bottom of the pool, and great numbers of individuals may be dug up in winter all clustered together. During this season certain 'fatty bodies,' situated on the top of the reproductive organs, and apparently degenerate portions of the kidney, become reduced in size, being probably the ovaries and testes, which become functional in the month of March. Then it is that the frogs congregate together for breeding purposes, and that the males with their vigorous croaking serenade their more weakly-voiced mates, preceding the birds in announcing the approach of spring. The titles bull-frog, blacksmith-frog, sugar-miller, &c., applied to certain species, obviously refer to their notable vocal powers.

The frog generally contains some interesting parasites—a hermaphrodite threadworm or Nematode (*Angiostomum* [illegible] the lungs, a fluke or Trematode [illegible] *Polystomum integerrimum*) in the bladder, and a ciliated Infusorian with many nuclei (*Opalina ranarum*) in the hindmost part of the alimentary canal.

Life-history.—The eggs of the frog are familiar to almost all; each is a little dark ball enclosed in a glutinous sheath which swells in the water into a clear round globe. The egg has most black pigment in its upper half, the heavier yolk sinking for the most part to the lower hemisphere. They are fertilised just as they leave the female, which the male is at the same time embracing. The division of the ovum is complete but unequal, the upper hemisphere with the 'formative protoplasm' soon exhibiting a larger number of smaller cells than the lower portion, which chiefly consists of yolk to be gradually absorbed by the embryo (see EMBRYOLOGY).

By the tenth day after the eggs are laid the head, body, and tail of the young frog may be distinctly seen. Following the lines of its ancestral history (*why* or *how* is a difficult question), the animal becomes fish-like, with a long tail and with three pairs of external gills on its neck. About a fortnight after the laying the young tadpoles are hatched, and, jerking themselves out of the gelatinous mass, swim freely in the water. They are still mouthless, and live on their still unexhausted capital of yolk. They have a paired sucker underneath their head, by means of which when tired they attach themselves to water-weeds or other objects. In a few days, however, they gain a mouth, 'bordered by a pair of horny jaws, and fringed with fleshy lips provided with horny papillæ.' The whole arrangement reminds one of that of the lamprey. As the tadpole hungrily feeds on fresh-water weeds (algæ, &c.), the hitherto short alimentary canal becomes elongated, furnished with a liver and pancreas, and, when the animal is big enough to dissect, may be readily seen coiled up like a watch-spring. About the time when mouth and anus have been opened the four gill-slits or clefts, opening from the pharynx to the exterior, may also be seen, and very soon the original external gills shrivel, and are replaced by an internal set. As the latter develop, a fold of skin grows over them, forming a gill-chamber which by-and-by closes so much that only a single exit aperture remains, and that on the left side. Through this the water taken in for respiration by the mouth passes to the exterior, after washing the gills on its way.

The tadpole thrives on [illegible] rapidly grows bigger and [illegible] a powerful swimming [illegible] suckers are less and less used. The limbs bud forth, but the anterior pair, hidden by the gill-covers above referred to, are longer of becoming distinctly visible. By the end of the second month the tadpole has attained to the level of the double-breathing fishes or Dipnoi (see FISHES); in other words, the lungs become useful, the gills for a while persist, but, as the animals get into the habit of coming oftener to the surface to breathe, these latter organs gradually degenerate.

Two or three weeks more, and a remarkable change—a metamorphosis—occurs, in which the tadpole rises above the fish level and becomes a distinct amphibian (see AMPHIBIA, for figures, &c.). The tadpole ceases to feed upon algæ, and begins to live at the expense of its tail, from which

wandering blood-cells or 'leucocytes' carry the nutriment to other parts of the body. A casting of the outer layer of skin takes place; the gills are finally lost; 'the horny jaws are thrown off; the large frilled lips shrink up; the mouth loses its rounded suctorial form and becomes much wider; the tongue, previously small, increases considerably in size; the eyes, which as yet have been beneath the skin, become exposed; the fore-limbs appear, the left one being pushed through the spout-like opening of the branchial chamber, and the right one forcing its way through the opercular fold, in which it leaves a ragged hole' (Milnes Marshall). As these momentous changes progress, and as the supply of food afforded by the tail begins to be exhausted, the animal recovers its appetite, but this time carnivorously, feeding on available animal matter, or even on its fellows. At this stage tadpoles will clean a skeleton beautifully, and Buckland describes them as showing a great avidity for animal food, crowding round a dead kitten, and nibbling at the toes of little boys who wade in pools where they abound. With the change of diet the abdomen shrinks, stomach and liver enlarge, the intestines become both narrower and shorter. The tail shortens more and more till it is completely absorbed; the hind-limbs lengthen; and eventually the animal leaps ashore—a tiny frog. For a considerable time the tadpole appears to be neither male nor female, but differences in nutrition, &c. decide the question of sex. In ordinary circumstances there are about as many males as there are females, but Jung has shown that by increasing the quality of food from fish to beef, from beef to frog flesh, he could increase the percentage of females to about ninety. See EMBRYOLOGY, ENVIRONMENT, REPRODUCTION, SEX; while for details of life-history, Milnes Marshall's book should be consulted.

Distribution and Related Species.—The common Brown Frog (*R. temporaria*) is widely distributed in Europe and Asia; 'it is the most northerly of known species, ranging in Norway to beyond the seventieth parallel of latitude. In the Alps it still frequents the waters at an elevation of 8000 feet.' It is of course abundant in most parts of Britain, and is common enough in Ireland, where, however, it is said to have been introduced in 1696.

Of wider distribution is the Green or Edible Frog (*R. esculenta*), which also occurs in Britain, though not believed to be indigenous. Its habitat extends from Scandinavia to North Africa, from France to Japan. Widely distributed in the United States are two forms—the Shad- or Leopard-frog (*R. halecina*) and the Wood-frog (*R. sylvatica*)—which some regard as identical with our common species. The common Bull-frog of North America (*R. catesbiana*) is often brought to European zoological gardens, has an appetite big enough to engulph a sparrow, and a croaking power proportionate to its large size. Like the edible frog on the Continent, it is not unfrequently cooked. A large Indian species (*R. tigrina*), another relatively huge, toad-like species (*R. adspersa*) from tropical Africa, a single species from West Australia (*R. papua*), and another solitary form (*R. krefftii*) from the Solomon Islands deserve to be mentioned. The genus is unrepresented in the southern parts of South America and in New Zealand.

Related Genera.—The family of true frogs or Ranidæ includes about two hundred species, ranked in eighteen genera. They have always teeth in the upper jaw, and a certain technical peculiarity in the breastbone. One of the most curious forms (which have always teeth in the upper jaw) is the arboreal genus Rhacophorus, the 'flying frog' described by Wallace, in which the webs between both fingers and toes are much developed. The tips of the fingers are dilated, and serve for attachment to smooth or vertical surfaces. The arboreal habit is a resource which brings with it several physiological adaptations, which must not be too much insisted upon in classification, for, as Huxley observes, the common brown frog 'at a year old will climb up the vertical side of a glass vessel, flattening out the ends of its toes, and applying its belly against the surface of the glass, like a tree-frog.' Frogs, like other amphibians, are usually unrepresented in oceanic islands, but, besides the species of Rana already mentioned as occurring in the Solomon Islands, three forms of Cornufer, ranked among the Ranidæ, ought to be noted on account of their habitat in the Fiji Islands. The Dendrobatidæ form a family of small tree-frogs nearly allied to the Ranidæ, but without teeth. From one species (*D. tinctorius*) the savage tribes of some parts of South America are said to extract a deadly poison for their arrows. Less nearly allied to the Ranidæ are the toothless toads (Bufonidæ), the horned toad (Ceratophrys), the true tree-frogs (Hylidæ), the 'midwife-toad' or obstetric frog (*Alytes obstetricans*), the tongueless Surinam toad (*Pipa americana*), which are separately discussed (see TOAD, TREE-FROG, &c.).

The use of frogs for food is regarded with unnecessary prejudice in Britain, but is very common on the continent of Europe. The species chiefly used is the edible frog (*R. esculenta*), which greatly abounds in ponds and slow streams in France, southern Germany, and Italy. They are taken for the market by nets and by a kind of rake, and are sometimes specially fattened in preserves. The hind-legs are most frequently cooked, but other muscular parts may be utilised. They are usually dressed with sauces, and in flavour and tenderness are comparable to chicken. The African species (*R. adspersus*) is said to be much used by the native tribes, and the gigantic bull-frog figures as a rarity in the transatlantic menu. The frog furnishes a very convenient vertebrate type to the comparative anatomist, embryologist, and physiologist, and is in this connection much more useful than on the dining-table.

See AMPHIBIA, BULL-FROG, NEWT, TOAD, TREE-FROG; and for showers of frogs, SHOWERS. See also St George Mivart, *The Common Frog* ('Nature' series, Lond. 1874); A. Milnes Marshall, *The Frog: an Introduction to Anatomy, Histology, and Embryology* (3d ed. 1888); Ecker and Wiedersheim, *Anatomie des Frosches* (3 parts, 1864, 1881, 1882; trans. by Haslam, 1889); for figures, G. B. Howes, *Atlas of Practical Elementary Biology* (1885); Bell's *British Reptiles* (1839); Leydig's *Anura Batrachia d. Deutschen Fauna* (Bonn, 1877); Hoffmann in Bronn's *Thierreich*, VI. (1873–78); British Museum Catalogue of Amphibia; and Hatchett Jackson and Rolleston, *Forms of Animal Life* (1888).

Frog, FISHING. See ANGLER.

Frogbit (*Hydrocharis morsus-ranæ*), a small aquatic plant of the order Hydrocharidaceæ, allied to the water-soldier (Stratiotes), but with floating leaves.

Frogged, a term used in regard to uniforms, and applied to stripes or workings of braid or lace, as ornaments, mostly on the breast of a coat.

Frogmore, an English royal palace and mausoleum in the park of Windsor, Berkshire. The palace, purchased by Queen Charlotte in 1800, has been one of the dwelling-houses of the Prince of Wales since 1861. The mausoleum, a Romanesque edifice, cruciform in shape and surmounted by an octagonal dome, is consecrated to the memory of the Prince Consort, whose remains were transferred to it on 18th December 1862.

Frog-spit, or CUCKOO-SPIT. See FROTH-FLY.

Frohsdorf, a village in Lower Austria, 30 miles S. of Vienna, on the river Leitha, and near

the frontiers of Hungary. It is celebrated for its splendid castle, which acquired a kind of political importance from having from 1844 till 1883 been the rendezvous of the elder Bourbon party and the residence of the Comte de Chambord (q.v.).

Froissart, JEAN, was born at Valenciennes about 1337. His father was a painter of armorial bearings. He was educated for the church, but spent his youth in gaiety and dissipation, being, by his own confession, a dear lover of dances and carolling, of minstrelsy and tales of glee. 'My ears,' he says, 'quickened at the sound of uncorking the wine-flask, for I took great pleasure in drinking, and in fair array, and in delicate and fresh cates.' When he was twenty years of age, he began, at the command of his 'dear Lord and Master, the Sieur Robert of Namur, Lord of Beaufort,' to write the history of the wars waged during his days in France, England, Scotland, and Spain. The first part of his Chronicle, which deals with the events of the years 1326–56, was principally compiled from the writings of one Jean le Bel, Canon of Liége. Having completed this section of his work in 1360, Froissart set out on his long travels in quest of adventure and good company, and that brilliant spectacle of martial and courtly pageantry in which all through his life he found unsating delight. The first country which he visited was England, where he received a gracious welcome from Philippa of Hainault, the wife of Edward III. Philippa appointed him her secretary or clerk of her chamber, a post which he held for some years, but which he resigned on account of a hapless passion for a lady of Flanders. In 1364 he travelled through part of Scotland, riding, he informs us, on a grey palfrey with his valise behind him, and having a white greyhound as his only companion. His reputation as a poet and historian, his gay and courteous converse, secured him an honourable reception in Scotland as elsewhere. He was the guest of King David Bruce, and was entertained for fifteen days at Dalkeith Castle by William, Earl of Douglas, the exploits of whose house he has frequently celebrated in his Chronicle. In 1366 he journeyed to Aquitaine in the retinue of the Black Prince, who would not, however, allow him to accompany the Spanish expedition, but sent him back to his patroness, Queen Philippa. Two years later we find him in Italy, where he was present, along with Chaucer and Petrarch, at the marriage of Lionel, Duke of Clarence, son of Edward III., with Jolande of Milan, the daughter of Galeazzo Visconti. For a time he settled at Lestines, in the diocese of Liége, where he obtained a curacy, and where he confesses 500 francs very quickly passed from him to the vintners. 'It may be conjectured,' says Sir Walter Scott, 'that *they* were more obliged to his attention than any of his other parishioners.' Before 1384 he had attached himself to Wenceslas, Duke of Brabant, whose verses he collected along with certain pieces of his own, under the title of *Meliador, or the Knight of the Golden Sun.* On the death of Wenceslas, Froissart repaired to the court of Guy, Count of Blois, who persuaded him to devote himself to his Chronicle. The second volume of the work was finished about 1388, and about the same date its author set out from Blois on a visit to Gaston Phébus, Count de Foix. This journey, of which he has left a very entertaining record, he performed in the company of the good knight Espaing de Lyon, who told him of the deeds of emprise that had lately been done at the various towns and castles by which they passed in the course of their wayfaring. After making a long sojourn at Orthez with the Count de Foix, of whose court he has left us a description which is equally vivid and charming, Froissart, about the year 1390, settled for a while in Flanders, and resumed work on his Chronicle. In 1395 he again yielded to the old roving impulse. He revisited England, was cordially welcomed by King Richard II., and remained abroad for about three months. He then returned to Chimay, where he had obtained a canonry, and where he ended his days in 1410.

Froissart's famous book deals with the period between 1326 and 1400. Mainly occupied with the affairs of France, England, Scotland, and Flanders, he likewise supplies much valuable information in regard to Germany, Italy, and Spain, and even touches occasionally on the course of events in Hungary and the Balkan peninsula. Except in the first part of the work, he made little use of the writings of others. An historian-errant, he gathered his materials in courts and on highways, from the lips of the lords and knights, the squires and the heralds whom he encountered. The charm of his book is perennial. He is of all medieval chroniclers the most vivid and entertaining. 'His history,' says Sir Walter Scott (who called the work his *liber carissimus*), 'has less the air of a narrative than of a dramatic representation.' He was a born story-teller; his pages glow with colour; his narrative glides easily and gracefully along; and he is, on the whole, accurate and impartial in his statements. 'In certain of his battle-pieces,' says Villemain, 'Froissart's style is truly Homeric,' and the tribute is justly merited. The main defects in his work are the frequent repetitions and the negligent arrangement of the facts. He has been reproached for not having espoused the cause of the French against the English, as if it were to be expected that a Flemish priest, in his youth the favourite and secretary of Edward III.'s queen, should share the burning patriotism, the intense hatred of England that animated such writers as Alain Chartier and Eustache Deschamps. More plausibly might he be arraigned for indifference to the sufferings of the townsmen and peasants. He is enamoured of the pageants of chivalry, engrossed in the deeds of nobles and knights. No writer could well make less pretence to act the moralist's part, but hardly any historian has been so uniformly delightful. He was likewise the author of a considerable body of verses—*ballades, rondeaux, virelais,* &c.—an edition of which was published by Buchon (Paris, 1829). Buchon also produced an excellent edition of his Chronicle (15 vols. Paris, 1824–26). The work was translated in 1523–25 by John Bourchier, second Lord Berners (1467–1533), and of his version there is an edition by Utterson (2 vols. 1812); a modern translation is that of Colonel Thomas Johnes (4 vols. 1803–5).

Frome, or FROME SELWOOD, a market-town of Somersetshire, on the Frome, a branch of the Avon, 12 miles S. of Bath (19 by rail). The surrounding country is very picturesque, and the town, until modernised early in the 19th century by the formation of two wide thoroughfares, was a quaint old place, with narrow, crooked, steep streets. Its parish church is a fine Decorated building splendidly restored by the late Rev. W. Bennett (q.v.), with a spire 120 feet high, stations of the cross, and the grave of Bishop Ken. Frome's specialties are broadcloths and other fine woollens, and it also produces cards for dressing cloth, ale, silk, &c. Pop. (1851) 10,148; (1881) 9376. Till 1885 Frome returned one member to parliament. The once celebrated forest of Selwood was in the vicinity.

Fromentin, EUGÈNE, painter and author, was born at La Rochelle in 1820. He studied under Cabat the landscape-painter; and from 1842 to 1846 travelled in the East, which is the scene of almost all his works. His pictures are admirably true in their local colouring, and reproduce with

great spirit the free nomad life of the Arab and his steed. Among his more important works are 'Arabs attacked by a Lioness' (1868), 'Halt of the Muleteers' (1869), 'A Souvenir of Esneh' (1876), and 'The Nile' (1876). His 'Couriers,' 'Country of the Ouled-Nayls,' 'Springtime' (1861), and his 'Falconry in Algiers: the Quarry' (1863) are in the Louvre. But he was no less prolific with his pen than with his brush. He published an account of his travels in *Le Pays*, under the titles of 'Visites Artistiques' and 'Simples Pèlerinages' (1852–56); and 'Une Année dans le Sahel' (1858) recorded the results of his investigations for the Committee of Historic Monuments. He also produced a successful romance, *Dominique* (1863). English translations of his *Les Maîtres d'Autrefois* (1876), an admirable criticism upon the Dutch and Flemish painters, as well as of his Life by Louis Gonse (1881), have been published in America. He became a 'chevalier' of the Legion of Honour in 1859 and an 'officier' in 1869; and died at St Maurice, near La Rochelle, 27th August 1876. See Gonse, *Eugène Fromentin* (Paris, 1881).

Frond, in Botany, a term often used to designate the leaves of cryptogamous plants. It was originally introduced as distinctive of organs in which the functions of stem and leaf are combined. The term *leaf* is now very generally used even of mosses, ferns, &c., and the term *thallus* is applied to liverworts and lichens. In the case of many Algæ the term is often used to designate the whole plant except its organs of reproduction.

Fronde, the name (indicating the sling used by the boys of Paris in their mimic fights) given to certain factions in France during the minority of Louis XIV., which were hostile to the court and the minister, Mazarin, and gave rise to a series of civil dissensions from 1648 to 1654. The grasping and despotic policy of Mazarin, to whom Anne of Austria, the queen-regent, had abandoned the reins of government, had given offence to all classes. The entire nation was aflame with discontent: the nobles were jealous of the employment of foreigners in the chief offices of state; the people kicked against the oppressive taxation; the parliaments resented the wilful disregard of their authority. At length the parliament of Paris refused to register the royal edicts, more especially the financial measures increasing the burdens of taxation. Mazarin in retaliation ordered the arrest (26th August 1648) of the president and one of the councillors, Peter Broussel. Thereupon the people took up arms. The court fled to Ruel in October, but early in 1649 removed to St Germain. The populace and parliament were joined by the discontented nobles, Conti, Longueville, Beaufort, Turenne, and De Retz. But the arrival of Condé, the champion of the royal party, who proceeded to lay siege to Paris, soon turned the tide. An agreement was therefore come to between court and parliament at Ruel on 1st April 1649, the people being released from the obnoxious taxes, whilst Mazarin and the foreigners were allowed to retain their offices. This ends the movement called the Old Fronde, a contest carried on in the interests of the people. The New Fronde was at bottom a struggle between Condé and Mazarin. The nobles, especially Condé, were far from being satisfied with the compact of Ruel, and opened negotiations with Spain for assistance from the Netherlands. But on the 18th January 1650 the queen-regent suddenly arrested Condé, Longueville, and Conti. This arbitrary proceeding roused the provinces. The Duchess of Condé stirred up the south of France. The Duchess of Longueville (Condé's sister) won over Turenne, who threatened Paris, but was defeated at Rethel. Nevertheless the storm was so great that Mazarin was obliged to release the princes, and flee from the country. Now, however, a kaleidoscopic movement changed the relations of the principal actors in the affair. Condé withdrew to Guienne; De Retz was bribed by the gift of a cardinal's hat; Turenne went over to the court; and Mazarin was recalled and reinstated in power. Meanwhile, Louis XIV., who, having now attained his fourteenth year, was declared to be of age, endeavoured to induce Condé to return; but the latter, mistrusting these overtures, commenced a regular war against the court, until he was defeated by Turenne near Paris on 2d July 1652. Condé found refuge within the capital; but the citizens, grown weary of the whole business, opened negotiations with the king, only demanding the removal of Mazarin to return to their allegiance. This demand was complied with and a general amnesty proclaimed (1653). Condé, who refused to enter into the compact, repaired to Champagne; but, finding no one disposed to take up arms in his cause, he entered the Spanish service. Shortly afterwards Mazarin was once more recalled to Paris, and again entrusted with the reins of government. The parliament of Paris was completely humbled, so much so that its political existence was virtually suspended for a century and a half. Thus the royal power came forth victorious from the contest. See Ste-Aulaire's *Histoire de la Fronde* (2d ed. 1860), Bazin's *France sous Louis XIII. et Mazarin* (2d ed. 1846), and Fitzpatrick's *Great Condé and the Fronde* (1873).

Frontenac, Louis de Buade, Comte de, governor of New France, was born in 1620, entered the army in 1635, and at an early age became brigadier. In 1672 he was appointed governor of the French possessions in North America, to be recalled ten years later, in consequence of endless quarrels with his intendant and the Jesuits; but in spite of his violent temper he had gained the confidence of the settlers and the respect of the Indians, and in 1689, when to the horror of constant attacks from the Iroquois the misery of a war with England was added, he was again sent out by the king, as the only man who could rouse the despairing colonists to hope and action. During the next nine years he loosed his savage allies on the defenceless villages of New England, repulsed a British attack on Quebec, and so broke the power of the Iroquois that they were never again a terror to the colony. He died at Quebec in 1698. See Francis Parkman's *Count Frontenac and New France under Louis XIV.* (Boston, 1877).

Frontinus, Sextus Julius, a Roman author and administrator who flourished in the second half of the 1st century. In 75 A.D. he was appointed governor of Britain, where he conquered the Silures, and vigorously maintained the imperial authority. He was twice consul in the course of his life, and in 97 was made superintendent of the water-works at Rome. He died about 104. Several works are attributed to Frontinus, only two of which are certainly genuine, the *Strategematicon*, a treatise on the Art of War, in four books, and the *De Aquis Urbis Romæ*, in two. His works have been edited by Dederich (Leip. 1855).

Fronto, Marcus Cornelius, Latin rhetorician, was born at Cirta, in Numidia, about 100 A.D. In consequence of his reputation as an orator and pleader, he was entrusted by Antoninus Pius with the education of Marcus Aurelius and Lucius Verus. In 143 he was consul. He died about 170. The two series of Fronto's letters to Marcus Aurelius, discovered by Mai in 1815, do not bear out the reputation for eloquence and intellectual force ascribed to the rhetorician by his contemporaries.

A critical edition was published by Niebuhr in 1816, and another by Naber in 1867.

Frosino'ne (*Frusino* of the Volscians), a town of Italy, 60 miles SE. of Rome by rail, with remains of an ancient amphitheatre. Pop. 7018.

Frost. The term frost is used to describe the condition of bodies containing moisture when their temperature is below 32° F., the freezing-point of water. When the substance in question is the air, everything exposed to its influence and not otherwise heated passes also below the freezing-point. In no part of the British Isles, within 1000 feet of sea-level, is the average temperature at any time of the year below 32°; and therefore the frosts experienced in Britain, though often lasting several days or even weeks, are essentially sporadic and of the nature of interruptions in the general character of the weather. It may be noted in passing that when severe frosts do occur, covering the rivers and lakes with ice, the weather is usually settled, there being a high barometer and little wind; so that the air over the British Isles or those parts of them where the frost prevails is not liable to be mixed with air from the warmer regions above the seas around. Loch Ness is one of the few lakes in Britain never known to freeze: its great depth prevents the cold having time to cool the whole mass of the water even in the longest and severest frosts that have occurred within the memory of man. Other large but shallower lakes, such as Loch Lomond, on the contrary get sufficiently frozen over to bear skaters and curlers during every exceptionally cold winter. A frequent and disagreeable effect of frost is the bursting of water-pipes, due to the expansion of water in the act of freezing. The breakage is not usually noticed till a thaw sets in and the water again circulates in the pipe, hence it is sometimes erroneously supposed that the thaw has burst the pipe.

Local low temperatures are often found in valleys when the air at a little height up is considerably warmer, producing what is known as an 'up-bank thaw.' This is caused by the air chilled by radiation from the sides of the hills settling down from its greater weight, and occurs on every night when there is not enough wind to mix the different layers together. In fact, on calm mornings a stream of cold air flows down valleys like their rivers, and often indicates its presence by the fog caused by its coming in contact with the damp air above the watercourses. In choosing sites for houses or gardens a less liability to great cold and damp fogs will be secured by placing them on knolls or a little up the sides of the hill than if they are planted in the bottom of the valley, and thus in the influence of this cold current. A position directly opposite the mouth of a valley is also to be avoided.

Frost may be present on the ground or on plants when the air is several degrees above the freezing-point. This hoar-frost is due to cooling by radiation (see RADIATION)—i.e. to the ground, leaves, &c. radiating their heat away faster than it can be replenished from the air around. Hoar-frost is most liable to occur on clear nights, clouds acting as a screen to check radiation, and is more common in country districts than in towns, where the smoke serves a similar purpose. It is the frost most dangerous to vegetation—coming as it does in clear weather when the air is otherwise warm, the days often hot from strong sunshine, and the tissues of the plants full of sap. It may sometimes be foretold by observing the hygrometer; if the dew-point (see DEW) is below 32° in the afternoon, hoar-frost may be expected at night. At the same time it is frequently a sign of warm days, as the low dew-point indicates that little moisture is present in the air to check the sun's rays. Hoar-frost being wholly due to radiation, it is a common custom to protect plants by spreading some light covering over them, or even by burning leaves, brushwood, &c. to make a smoke of sufficient density to act as a screen. This is usually effectual, but may fail either from the air cooling below 32°, in which case the covering is almost useless; or by injuriously checking the circulation of air and confining a small quantity immediately over the plants, which, getting cooled by contact with the ground below the temperature of the free moving air around, may pass below 32° and allow the vegetation to be frost-bitten.

A well-known form of frost, closely allied to hoar-frost, is the crystalline deposit seen when the moisture in the air of a warm room condenses on the glass of the window. It takes most beautiful and varied forms, owing to the tendency of ice deposited in this manner to form hexagonal crystals.

Another form of deposition is fog-crystals, which appear whenever a frosty fog is accompanied by wind, the fog drifting along and depositing spicules of ice on all surfaces exposed to it. As frosty fogs in low-lying districts occur usually in calm weather fog crystals are not often observed there, but are of frequent occurrence on hills, where the driving mists cover all projecting stones, trees, &c., with great masses of loose feathery crystals, often reaching a thickness of several feet. Great damage is sometimes caused to trees and shrubs by rain falling immediately after frost, before the ground and the air near it has time to thaw. The rain freezes as soon as it touches any objects, and gradually encrusts them with solid ice, until even large branches of trees break down under the weight. For other matters connected with freezing and its effects, see ICE, TEMPERATURE, THERMOMETER, GLACIER, HAIL, SNOW, FREEZING MIXTURES, &c.

Lists of the most memorable frosts on record will be found in W. Andrews's *Famous Frosts and Frost-fairs in Great Britain* (1887), and in C. Walford's paper on 'Famines' in *Journal of the Statistical Society* (1878). Fairs were held on the ice on the Thames in 1564, 1607–8, 1620, 1683–84 (especially celebrated), 1688–89, 1715–16, 1739–40, 1788–89, 1813–14. The western parts of the Baltic were frozen, and in most years passable for men and horses, in 1294, 1296, 1306, 1323, 1349, 1402, 1459–60, 1548, 1658, 1767. Flanders and Holland were visited by unusually severe frosts in 1468, 1544, 1565, 1594, 1622, 1734, and 1785. Besides these, other memorable frosts occurred in the years and countries mentioned in the subjoined table:

401, 763–4. Seas near Constantinople.	1737. Italy and Spain.
859–60. Mediterranean and Adriatic.	1740. Denmark and Prussia.
1035. On Midsummer Day in England.	1745. Russia.
1076–77. England.	1760. Germany.
1234. Mediterranean.	1763. Germany and France.
1420. Sea near Constantinople.	1766. Naples, Lisbon, Bavaria, and France.
1433. Germany.	1767. Italy and North Europe.
1594. Adriatic at Venice.	1783–84. Central and southern Europe.
1622. Hellespont.	1812. Russia.
1670. Rhine frozen.	1815. Canada.
1691. Austria.	1849. Norway.
1693. Italy and Germany.	1873. France.
	1888. Blizzard (q.v.) in U.S.

Frost-bite is caused by cold depressing the vitality of a part or the whole of the body. The frost-bitten part is at first blue and puffy, from the current of blood through it being much retarded; then, should the cold be continued, it becomes pallid, and the painful tingling gives place to numbness and insensibility, and finally to actual death or *mortification*, with a dark livid appearance of the part. Although a sudden violent application of cold may cause death of the tissues, by reducing the temperature to a degree incompatible with animal life, the most common cause of the destructive effects of frost-bite is undoubtedly the excessive

reaction which occurs on sudden removal of the cold, or the application of heat; this is especially the case with moist cold.

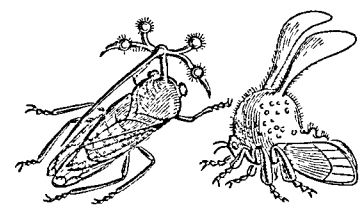
Baron Larrey believed that 'cold was merely the predisposing cause of frost-bite, and mentions that after the battle of Eylau the French soldiers did not experience any painful sensations during the severe cold varying from 10° to 15° below zero of Réaumur's thermometer; but, when the temperature rose from 18° to 20°, they felt the first sensations of cold, and applied for succour, complaining of acute pains in their feet, and of numbness, heaviness, and prickings in the extremities. The parts were scarcely swollen, and of a dull red colour. In some cases, a slight redness was perceptible about the roots of the toes, and on the back of the foot; in others, the toes were destitute of motion, sensibility, and warmth, being already black, and, as it were, dried.' Those of the men who indulged in the warmth of the bivouac fires suffered from frost-bite in much larger proportion than their more hardy comrades. But 'the extent of disaster from this cause even in modern campaigning may be judged from the fact that in the French army before Sebastopol 2800 cases occurred in two nights, and of this number 900 subsequently died.'

In Great Britain cases of frost-bite are comparatively rare. Occasionally, in severe winters, cases present themselves at the hospitals in the persons of houseless, ill-nourished unfortunates, whose constitutions have in many instances been enfeebled by spirit-drinking.

The treatment of frost-bite consists in coaxing back by degrees the vitality of the part; this is most prudently effected by rubbing the part in a cold room, at first with snow, then with water at ordinary temperature, and when warmth returns by enveloping it in cotton-wool or flannel without applying heat. As the coldness subsides, the painful tingling returns, then redness and heat; in a short time the latter will be above the natural standard, and, if the reaction is severe, the part will inflame, and perhaps mortify. It is well to remember that the part need not have been actually frozen for these symptoms to occur. The person with languid circulation who, coming home with cold wet feet, places them before the fire, or in warm water, may be 'frost-bitten' to all intents and purposes.

Frog-hopper (*Aphrophora spumaria*): *a*, larva; *b*, perfect insect, with wing-covers closed; *c*, perfect insect, in the act of flight; *d*, the froth on a plant.

Froth-fly, also called FROTH-HOPPER, FROG-HOPPER, FROG-SPIT, common names for numerous insects parasitic on plants, on which the larvæ and pupæ are found surrounded by a frothy spittle. They are included in the family Cicadellidæ in the order Homoptera, and are related to the Aphides, Cicadas, and Lantern-flies. The family is a very large one; the members are all plant parasites, mostly small in size, often very beautiful in form and colour. The young stages, which are very like the adults, except in the absence of developed wings, suck their plant hosts, and thereupon surround themselves with the familiar froth which issues from the hind end of the gut. The froth is popularly called cuckoo-spit or frog-spittle, from fancies entertained as to its origin. It is sometimes so abundant, on willows for instance, that it drops from the branches. In some cases it may be helped by an exudation from the wounded plants. The adults have long hind-legs, and are able to hop about with some activity. The commonest British species, *Aphrophora spumaria*, is a yellowish-green insect, towards half an inch long, particularly addicted to willows; another common green form, *Tettigonia viridis*, is prevalent in meadows; *Cercopis sanguindenta*, in red and black, also occurs; while Typlocyba, Jassus, and Ledra are abundantly represented in Europe. In tropical countries the Cicadellidæ are still more plentiful and beautiful. The nearly-related family Membracidæ includes many most extraordinary insects (see fig.)—e.g. in the genera Bocydium and Centrotus, with bizarre outgrowths from the first segment of the thorax.



Bocydium cruciatum. Bocydium globulare.

Froude, JAMES ANTHONY, an eminent English historian, was born at Dartington, near Totnes, Devonshire, 23d April 1818. The youngest son of the Archdeacon of Totnes, he was educated at Westminster and Oriel College, Oxford, took a second-class in classics in 1840, and in 1842 was elected a Fellow of Exeter College. He took deacon's orders in 1844, and was sometime under the spell of Newman's influence, but ere long his opinions underwent a fundamental change, as revealed to the world in 1848 in his outspoken book, *The Nemesis of Faith*, a work in which the solemnity and sadness of religious scepticism are relieved by a singularly tender and earnest humanity. The book was written with great and even startling power, and not only cost Froude his fellowship, but also an educational appointment in Tasmania. For the next few years he employed himself in writing for *Fraser's Magazine* and the *Westminster Review*, and in 1856 issued the first two volumes of his *History of England from the fall of Wolsey to the defeat of the Spanish Armada*, completed in 12 vols. in 1869. In this work Froude shows supreme literary ability—no reader can ever forget his narrative of the death of Mary Stuart and the disasters that befell the great Armada. In the art of making history as fascinating as fiction Macaulay is his only rival. But like him he is a man of letters first and an historian afterwards, and the defects of his merits have sadly impaired the permanent value of his work. As has been said with truth, he taught himself history by writing it; still his use of his materials never becomes critical, and his views of men and motives are always distorted by being seen through 19th-century spectacles, and these, moreover, spectacles of his own. Natural love of paradox and the faculty of seeing easily what he wished to see helped him to make a hero of Henry VIII.—the greatest blot upon his history. Four volumes of remarkably brilliant essays and papers, entitled *Short Studies on Great Subjects*, appeared between 1867 and 1882. Froude was elected rector of St

Andrews University in 1869, and received the degree of LL.D. For a short time he was editor of *Fraser's Magazine*. His next history, *The English in Ireland in the Eighteenth Century* (3 vols. 1871–74), showed the same merits and the same defects as the greater work, and the same may be said of his *Cæsar: a Sketch* (1879), a subject for the treatment of which he possessed but one qualification—consummate style. In 1874, and again in 1875, Froude visited the South African colonies on a mission from the home government, and published his impressions in *Two Lectures on South Africa* (1880). As Carlyle's literary executor, Froude edited his *Reminiscences* (1881), Mrs Carlyle's *Letters* (3 vols. 1882), and Carlyle's own *Life* (4 vols. 1882–84); and by giving to the world the copious personal criticism and family details contained in these works, he suggested grave doubts as to his editorial discretion. Later works are *Oceana* (1886), a delightful account of a voyage to Australia and some of the Pacific Islands, *English in the West Indies* (1888), and *The Two Chiefs of Dunboy* (1889), an historical romance of Irish life towards the close of the 18th century. The first two were violently assailed by colonial journalists as pictures rendered untruthful and misleading by the personal bias of the writer. —His elder brother, RICHARD HURRELL FROUDE, a leader in the Oxford Tractarian movement, was born at Dartington, in Devonshire, 25th March 1803. After graduating at Oxford in 1824 he became Fellow and tutor of Oriel College. Tracts 9 and 63 were from his pen. He died on 28th February 1836. His *Remains* were published three years after his death by Keble and Newman. —Another brother, WILLIAM FROUDE, engineer and mathematician, born in 1810, and educated at Westminster and Oriel College, Oxford, was trained to be a civil engineer, and in 1838 became assistant to Brunel. Retiring from professional work eight years later, he devoted most of his time thenceforward, down to his death at the Cape, 4th May 1879, to investigating the conditions of naval construction and the laws upon which the motions of vessels at sea depend—i.e. he sought to determine the laws of wave-resistance, of marine propulsion, the rolling of vessels, effects of deep bilge keels, and the best forms of rudders and propellers.

Frozen Strait, a passage, about 15 miles wide, separating Southampton Island, in the north of Hudson Bay, from Melville Peninsula.

Fructidor (Eng., 'fruit-month') was the name given in the republican calendar of France to the period extending from the 18th of August to the 16th of September (see CALENDAR). The 18th Fructidor of the year 5 (4th September 1797) is celebrated as the day on which a *coup d'état* on the part of members of the Directory (q.v.) saved the republic from the machinations of the royalists.

Fructification (Lat., 'the producing of fruit'), a term frequently employed in botany, especially of cryptogams, sometimes to denote the whole reproductive system, and sometimes the 'fruit' itself. See FUNGI, SEAWEEDS.

Fructose, or FRUIT-SUGAR. See SUGAR.

Frugoni, CARLO INNOCENZO, an Italian poet, was born at Genoa in 1692, and taught rhetoric at Brescia, Genoa, and Bologna, and died in 1768. He belonged to the 'Arcadian' group, and wrote odes, epistles, and satires, and was famous with his contemporaries for versatility and elegance, but is now all but forgotten.

Fruit. In popular language, the term fruit is very vaguely employed. When extended beyond the common limitation of usefulness to man or beast, it tends to be applied to any plant-structure, phanerogamic or cryptogamic, which contains the germ of the new individual—to all the organs of fructification in short. But, as common observation deepens into botany, we find ourselves gradually led to the more precise restriction of the term fruit to the ovary of angiosperms (monocotyledons or dicotyledons) after fertilisation (see FLOWER, OVARY).

The numerous and interesting adaptations of different fruits to the preservation and distribution of the seed will be more conveniently outlined under SEED, while the periodic rhythm between vegetative and reproductive growth to which the question of fruit attracts our attention must be discussed under the more general head of REPRODUCTION. The special structure and physiology of fruits here remain to be considered.

Since the dawn of modern botany, the multifarious forms of fruit have led to many attempts at their classification. Yet the student is more apt to be overwhelmed by the resulting disorderly and redundant nomenclature of the subject than impressed by its systematic clearness. If, however, we keep fast hold of the elementary conceptions of vegetable physiology, morphology, and evolution, the difficulty of enumerating and classifying the various forms of fruit becomes greatly diminished. We must of course assume a knowledge of the general morphology of the Flower (q.v.).

Starting then with those simplest flowers in which all the carpels are separate, we find the stigma and style usually withering back as no longer of service, and the ovary enlarging, as the fertilised ovules grow up into seeds. But in many such simple flowers more ovules are produced than are fertilised, and generally also more fertilised than can be developed up to maturity; hence the reduction of the ovules is exceedingly common. The alternative of reducing the number of carpels also commonly appears: hence in the same order of Ranunculaceæ we have on the one hand the anemone with its multitude of small ovaries which only mature a single ovule, and on the other the larkspur or monkshood with few carpels, but these many-seeded. This process of reduction of the number of carpels or ovules, or of both, has not only taken place in the process of past evolution of the great majority of plants, but is still frequently to be observed in the development of the individual, as is well seen by comparing the characteristically one-celled and one-seeded acorn with a section of the three-celled and six-ovuled ovary from which it actually arose in spring, or, more simply, by recalling to memory the abortive ovules and the corresponding abortion of one or two of the original three divisions of the ovary in the fruit of the horse-chestnut.

A second common-sense 'principle of fruit-making,' as we may call it, is reached through keeping clearly in mind the nature and origin of the ovary; for, however the upgrowth of the axis may in perigynous or epigynous flowers conceal this (see FLOWER), we know the ovary primarily to have arisen from one or more carpellary leaves, of which the individual development has been so greatly checked (doubtless through the precocious development of their sporangia—i.e. ovules), that so far from becoming expanded like all other appendages, they remain closed upon the ovules, and frequently even coalesce with each other from the base upwards, so forming a many-celled ovary, often even with united styles or even stigmas. Yet the tendency to their individual expansion is not lost; in many monstrosities, and normally a few types, such as the common mignonette, the carpellary leaves early begin to expand, so opening the ovary and exposing the seeds long before ripeness. Far more frequently, however, this final development of the

carpellary leaves is delayed until the growth-processes of the seed and fruit have ended, and it is therefore accompanied, or even preceded, by their death; the separation often indicating the lines at once of leaf-margin and leaf-fall.

In the best developed carpellary leaves, such as those of the more floral Ranunculaceæ, we naturally find the ovary 'dehiscing along the ventral suture'—in more simple and less empirical language, the carpellary leaf opening along the line of its united ovule-bearing margins. This is what is termed a *follicle* (fig. 1, *f*).

Since, however, the ovules are on the united-margins, the midrib tends to become mechanically unimportant, and to interpose little or no resistance to a tendency to split or tear along its fold, as well as to open along the united margins. Such 'dehiscence by both dorsal and ventral suture' gives us the modification of the follicle known as a *legume* or *pod* (fig. 1, *e*).

A very familiar type, which must not be confused with the pod, is the *siliqua* (or when shortened and broadened the *silicula*) of Cruciferæ. Here the placental edges of two united carpels develop a transverse septum which divides the fruit (fig. 1, *d*); and this is left when the lobes split away, as so familiarly in Honesty.

Among united ovaries which readily split open at the united margins (*septicidal*) we may note that of Gentian (q.v.), while the more familiar three-celled ovary of a violet (fig. 1, *b*) or rock rose with its parietal placentation gives a characteristic example of dehiscence along the midribs of the united carpels, so opening the loculi (*loculicidal*). In the five-celled capsule of the Geranium (q.v.) the carpellary leaves separate not only at the

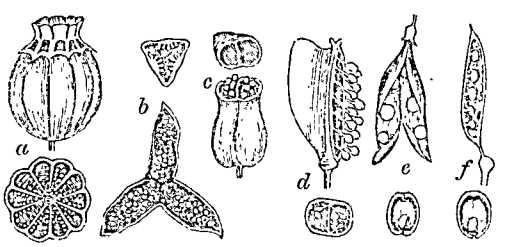


Fig. 1.
f, follicle; *e*, legume; *d*, silicula; *c*, capsule of henbane; *b*, of violet; *a*, of poppy.

sides but also at the base, so curling inwards and projecting the seed. In Colchicum, white hellebore (Veratrum), and their allies (Melanthaceæ) the dehiscence is characteristically septicidal, the carpels separating instead of the loculi opening: the remaining majority of Liliaceæ are loculicidal. Where, however, the placentæ remain more or less completely upon a central column from which the valves are detached, the dehiscence is said to be *septifragal*.

In henbane (fig. 1, *c*), Anagallis, &c. the dehiscence is circular (*circumscissile*); the possible explanation of this as a disarticulation of the united carpels by their leaf-bases is, however, rendered difficult through the separated portion being a mere lid. Many-celled capsules are numerous in which the leaf-opening or dehiscence is greatly reduced from completeness, witness the *valvular* and *porous* dehiscence of the Lychnis and of the poppy (fig. 1, *a*) respectively. Such cases clearly point us to those of carpels which do not open at all. Such *indehiscent* fruits, produced from carpels so persistently embryonic, are, as we might expect, usually short, few or one-ovuled, and, for the most part, little specialised. Thus the follicle of the Ranunculaceæ of more specialised floral character becomes shortened into the one-seeded indehiscent *achene* of the anemone or buttercup (fig. 2, *e*, *f*). In the achene of the grasses (which similarly represents the capsule of the ancestral lilies) the thin dry pericarp becomes inseparable from the seed-coat (hence the term *caryopsis*, fig. 2, *c*, *d*); in many trees (e.g. hazel) it becomes hardened and thickened as a *nut*. In composites (fig. 2, *a*, *b*), too, the achene is practically a nutlet, although often (on account of its being inferior) termed a

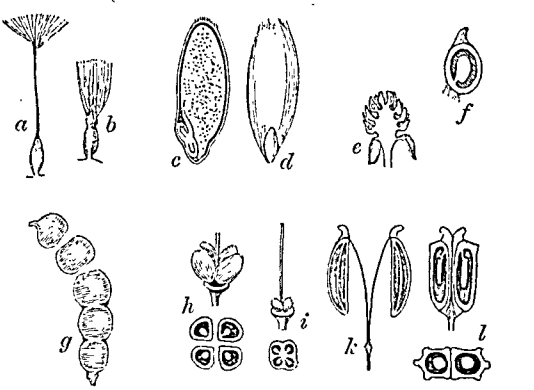


Fig. 2.
of oat; *a*, *b*, achenes with ts and ovary of borage;

cypsela. Less extremely reduced representatives of the various multicellular ovaries to which such fruits correspond are afforded us by borages or labiates, in which the two-celled ovary of the primitive solanaceous type becomes, as in thorn-apple, &c., subsequently divided into four parts: these (see fig. 2, *i*, *h*), however, are here so arrested as only to develop a single ovule in each loculus (of which the subsequent growth brings about the perplexing appearance of the 'gynobasic' style). The four ripe 'nutlets' into which the four-lobed ovary of these forms commonly breaks up were not unnaturally mistaken by the old botanists for naked seeds. In Umbelliferæ we have another characteristic form of *schizocarp*, as all such fruits are termed which split up without truly carpellary dehiscence, although the tendency to this can be seen still to have some influence. Here the separate portions (or *mericarps*), each resembling an achene or nut, are two in number, and when ripe swing off upon the ends of a forked *carpophore* (fig. 2, *l*, *k*).

In exceptional cases we have the pod of some Leguminosæ and the siliqua of some Crucifers—e.g. radish, snapping off into one-seeded joints, instead of dehiscing longitudinally in the regular way. This simply comes about where the swellings corresponding to the seeds become unusually large, leaving narrowings between them, and thus giving the pod a strength of form too great for the usual tension of ripeness to overcome (fig. 2, *g*). To confuse such distinct types of fruit under a common term (*lomentum*), and to separate them from the normally dehiscent capsules to which they really belong, and to place them among the purely 'schizocarpous' fruits we have been describing, although still too customary, are merely examples of the reasoned mistakes inseparable from a purely descriptive anatomy, but from which the evolutionary standpoint is at length delivering us.

So far all our fruits have been dry; but a new physiological 'principle of fruit-making' is necessary to comprehend those in which the pericarp is succulent. For, just as the effect of fertilisation is seen in many animals to extend beyond the mere ovum to the parent organism, and also in many of

the lowest plants, so it is in the case before us. Even in fruits which are dry on ripening we have seen that the ovaries or loculi, on which no demand is made for the growth of fertilised ovules, become reduced or disappear. Sometimes it may be merely the coats of the seed (as in the pomegranate) which undergo the complex histological and chemical changes which we sum up as those of succulence and ripening; at other times largely their placentas, as in the gooseberry and currant. Yet, as in these, the innermost tissue of the ovary may become succulent as well. In the orange also the familiar succulent tissue in which the seeds are immersed are the enlarged succulent cells of the *endocarp*; the grape too gives a characteristic example of soft endocarp. These may all be classed as berries or baccate fruits, for the distinction of the succulent product of an inferior ovary as a berry, from that of a superior one, as a *uva* or grape, need hardly be allowed to increase our nomenclature. A *pepo* is merely a berry in which the epicarp is thick and tough (e.g. a melon, with which the orange and pomegranate may be reckoned). Where the succulent change, instead of primarily affecting the

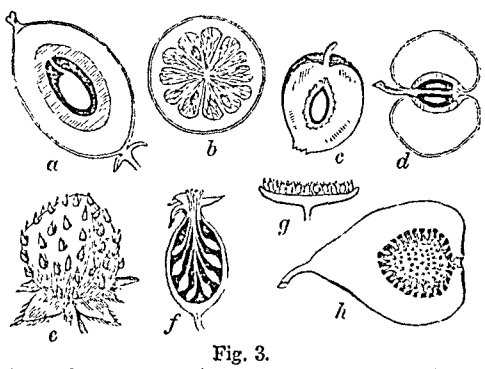


Fig. 3.

a, drupe; *b*, orange; *c*, a single drupelet of bramble; *d*, pome; *e*, strawberry; *f*, hip of rose; *g*, capitulum of Dorstenia; *h*, fig.

deeper tissues of the fruit, and so producing a berry, leaves the endocarp hard, we have evidently a well-contrasted type—the drupaceous or stone-fruit. The endocarp here forms a more or less complete 'stone' around the kernel or seed, the difference from an ordinary nut being due to the succulence of an outer layer, as *mesocarp*, with a more or less leathery outer skin, the *epicarp*. The plum, peach, and nectarine are the most obvious examples; but, since we may have many carpels thus transformed, we may have an aggregate fruit or syncarp of tiny drupes. The walnut and even cocoa-nut are hence not true nuts (see NUT). The immature succulent mesocarp of the former is familiar in pickles, the walnut we crack being merely the stony endocarp (which is exceptionally specialised in being set free by the bursting of the mesocarp on ripening). The familiar cocoa-nut fibre is the fibro-vascular tissue of the mesocarp, the fruit being thus broadly comparable to a peach which has wizened while still young and stringy. But, as in the kindred grass, the coats of the ovule further unite to the endocarp.

The numerous carpels of the strawberry, although, of course, corresponding to those of the allied raspberry, remain mere nuts; here, however, the subjacent portion of the floral axis or *receptacle* becomes succulent. In the perigynous or epigynous Rosaceæ the same change may take place; hence the rose-hip is a succulent axis, enclosing a multitude of nuts. The apple or 'pome' is more akin to the drupe, since the carpels, here deeply sunk in the upgrown floral axis, develop a hard endocarp corresponding to the stone of a drupe.

Fertilisation may even be followed by succulent or other thickening of the floral envelopes, or of the floral axis with subjacent bracts—the various *cupules*, as of acorn, beech, hazel-nut, &c., being of this nature. Or we may have a spurious fruit developed at the expense of an entire inflorescence, as in the pine-apple, Dorstenia, and fig. See INFLORESCENCE.

Fruits Important to Man.—The list of the fruits of any importance is much shorter than would at first be supposed, as may be seen from the following enumeration (practically that of Frank), which distinguishes those native or cultivated in northern Europe (Germany and Britain) from the more important foreign fruits, and of course employs the terms stone-fruits, berries, &c. in their merely popular sense.

I. *Indigenous or Cultivated:* (1) *Apples or Pip-fruits.*—Apple (*Pyrus Malus*), Pear (*P. communis*), Medlar (*Mespi* ... Quince (*Cydonia japonica*), Ser ... *torminalis* and *S. domestica*), to which may be added Hips (*Rosa canina*, &c.) and Haws (*Crataegus Oxyacantha*), also Cornel-berries (*Cornus mascula*).

(2) *Stone-fruit.*—Peach and Nectarine (*Persica vulgaris*), Apricot (*Prunus armeniaca*), Plum (*P. instititia*), Cherry (*P. Cerasus* and *P. avium*), Damson (*P. domestica*), Greengage (*P. italica*), Sloe (*P. spinosa*), Cherry-plum (*P. cerasifera*), &c.

(3) '*Berries.*'—Grape ... Strawberry (*Fragaria vesca, elati* ... (*Rubus Idæus*), Bramble or ... *dicosus*), Gooseberry (*Ribes Grossularia*), Red Currant (*R. rubrum*), Black Currant ... (*Berberis vulgaris*), Black ... White Mulberry (*M. alba* ...; (*Vaccinium Myrtillus*) with its minor congeners, Juniper (*Juniperus communis*).

(4) *Nuts or Shell-fruit.*— Hazel-nut (*Corylus Avellana*), Filbert (*C. tubulosa*), Walnut (*Juglans regia*). See NUTS.

II. *More Important Fruits of Warm, Temperate, and Tropical Regions:* (1) *Stone-fruit.*—Date (*Phœnix dactylifera*), Olive (*Olea europæa*), Mango (*Mangifera indica*), Tahiti-apple (*Spondias dulcis*), Mombin Plum of West Indies (*S. Mombin*), Avocado Pear (*Persea gratissima*), Icaco or Cocoa Plum (*Chrysobalanus icaco*), Sapota Apple (*Achras Sapota*).

(2) *Berries and Berry-like Fruit* (in widest sense of succulence).—Banana and Plantain (*Musa paradisiaca*), Pine-apple (*Ananassa sativa*), Fig (*Ficus Carica*), Bread-fruit (*Artocarpus incisa* and *integrifolia*), Custard Apple (*Anona squamosa*, &c.), Baobab (*Adansonia digitata*), Orange, Lemon, Lime, Citron, Shaddock, Pompelmoose, Forbidden Fruit, Bergamot, and other species of *Citrus*, Pomegranate (*Punica granatum*), Guava (*Psidium piriferum*), Rose-apple of East Indies (*Jambosa domestica* and *vulgaris*), Tamarind (*Tamarindus indica*), Carob or Locust Bean (*Ceratonia siliqua*), Papaw (*Carica Papaya*), Pumpkin (*Cucurbita Pepo*, &c.), Melon (*Cucumis Melo*), Water-melon (*C. Citrullus*), Cucumber (*C. sativus*), Tomato (*Lycopersicum esculentum*), Lotus (*Diospyros lotus*), Jujube (*Zizyphus vulgaris*), Mangosteen (*Garcinia Mangostana*), Prickly Pear (*Opuntia vulgaris*).

(3) *Nuts or Shell-fruit.*—Cocoa-nut (*Cocos nucifera*), Almond (*Amygdalus communis*), Chestnut (*Castanea vesca*), Litchi or Lee-chee (*Nephelium Litchi*) (really, however, a shelled drupe), Brazil-nut (*Bertholletia excelsa*), &c.

Chemical Composition of Fruits.—Our knowledge of the chemistry of fruit may be dated from the analyses of Fresenius (1857). But because of the innumerable varieties of almost every cultivated fruit, the effects of different soils and climates

upon these, and still more of the fluctuation due to better or worse seasons, the results of any one chemical analysis would tend to convey an idea of undue precision. Thus—e.g. while the ratio of sugar to free acid in certain grapes of an ordinary wine-year was found to be 16 to 1, in a very bad year it sank to 12, and in a very good year rose to 24. Hence a broad outline may be of more general use than the statistics of any one analysis.

The percentage of water may be taken as varying from 78 to 80 in the grape and cherry, as from 82 to 85 in plums, peaches, apples, and pears, as 82 to 87 in brambles, currants, &c., and as much as 95 in the water-melon. The proportion of insoluble residue—skin and cellulose, stone and seed—obviously also varies greatly with succulence and ripeness, but may be taken, one fruit with another, at not less than from 4 to 6 per cent. Unripe fruits may contain a notable proportion of starch, but this is fermented on ripening into glucose and other sugars, fruit-sugar, grape-sugar, cane-sugar, or (in *Sorbus*) sorbin. The only fruits which retain starch in important quantity are those of the banana, bread-fruit tree, and baobab; hence the exceptional nutritive value of these. The olive alone yields a notable proportion of oil. The proportion of sugars varies exceedingly, dates, dry figs (48 per cent.), and raisins (56 per cent.), again very important foods, heading the list. Grapes of course stand high, from 12 to 18, indeed sometimes as much as 26 per cent., cherries from 8 to 13, apples 6 to 8, pears 7 to 8, plums 6, red currants 4·75, greengage 3·5, peach and apricot only 1·5. The proportion of pectin bodies is, however, exceedingly notable, especially in fruits such as the three last named. In unripe fruits (as also in roots) we find *pectose*, a body apparently related to cellulose, but easily transmuted by a natural ferment or by boiling with dilute acid into pectin, $C_6H_6O_4$, and its allies. These are all more or less soluble in water, with which they readily form a jelly (whence the peculiar consistency of our fruit-preserves). The proportion of soluble pectin and gum varies considerably and is of great importance to the blandness and agreeableness of fruit, the harder and more common apples having considerably less than 3 per cent. and the best rennets nearly 8. The harsh red currant, indeed, like berries in general, has exceedingly little (0·25 per cent.); while the apricot has as much as 9, the greengage 12, and the peach 16—a circumstance which explains the peculiarly melting quality of these fruits, especially the last named. The free acid also varies greatly, from 2·4 per cent. in the red currant, 1·4 in the raspberry, and nearly as much in the sourest cherries, to 0·5 in sweet cherries and a minimum of 0·1 or less in the sweetest pears. That of apples and of grapes, of course, varies greatly, but both may generally be taken at from 1 to 0·75, while the apricot and peach stand at 0·3 or 0·4. The acid is primarily malic, but citric, acetic, oxalic, tannic, and others may also be present.

The quantity of albuminoids is of course small, in fact inadequate to render most fruits a staple food. Yet it is by no means inappreciable, ranging from nearly ·5 per cent. in the majority of fruits to ·7 or ·8 in the grape (2·7 in raisins), and above 1 in the melon and tomato. Hence to acquire albuminoids equal to those of one egg we must eat 1½ lb. of grapes, 2 lb. strawberries, 2½ lb. apples, or 4 lb. pears. To replace 1 lb. starch = 5½ lb. potatoes, we need 5·4 lb. grapes, 6·7 of cherries or apples, or 12·3 of strawberries (see FOOD).

The quality of fruits depends largely upon the proportion of sugar, gum, and pectin to free acid, largely also upon the proportion of soluble to insoluble matters, but in very great measure also upon the aroma. This quality is due to the presence of characteristic ethers, often accompanied by essential oils, although not of course in ponderable percentage. Cultivation and selection operate strongly on all three factors.

Keeping of Fruit.—Many of the finest fruits undergo very speedy decomposition, which, as distinguished from the intrinsic processes of ripening, is due to the attacks of bacteria, moulds, or yeasts; and the problem of their preservation is therefore primarily one of preventing these. In damp and stagnant air, especially with considerable or frequent changes of temperature, these fungus pests multiply with special readiness; hence a fruit-room must be cool and shady, yet dry and airy, and the fruit carefully gathered rather before full ripeness, handled so as to avoid in any way bruising or tearing the skin, and laid out and occasionally looked over so that rottenness in one may not affect the rest. Under these conditions apples especially may be kept for many months; indeed many varieties of fruit—e.g. winter-pears—require these conditions for satisfactory ripening. On antiseptic principles we see how it is that the dense-skinned and wax-coated grape can be so largely imported in sawdust, or how unripe gooseberries, and even very perishable pears can be kept for months similarly packed in well-sealed jars in a cool place. The process of preserving with sugar in jars promptly covered up is similarly an antiseptic one; but in the systematic application of antiseptic principles we may still look for considerable progress in the preservation and transport of fresh fruit upon a large scale. The method of drying fruit has also been in use from remote times, especially with dates, figs, and raisins; in America the drying of apples is of great and increasing importance.

The preparation of fruit-preserves is separately treated (see PRESERVES); and similarly that of fermented beverages (see WINE, CIDER, &c.). For Fruit Gardening, see GARDENING and the articles on the several fruits.

FRUIT TRADE.—The annual imports of fresh and dried fruits into Britain are very extensive, as may be seen from the table below for 1887. The items in the first part of the table are free of duty; but currants, raisins, figs, plums, and prunes pay a duty of 7s. per cwt.:

Oranges and lemons	4,807,360	bushels	£1,543,667
Unenumerated: Raw	2,478,101	"	1,166,318
" Dried	398,469	cwt.	336,929
" Preserved without sugar	20,820,673	lb.	187,216
Currants	1,100,737	cwt.	£1,438,320
Raisins	653,138	"	1,022,402
Figs and fig-cake	106,749	"	166,961
Plums	33,067	"	78,409
Prunes	17,150	"	21,830

Large and varied as is the produce of fruit in the United States, the imports are an important item of commerce. The duty-free fruits and nuts, mainly bananas and cocoa-nuts, had in 1887 a value of $4,767,659. In the same year the total value of imported fruit and nuts paying duty was $15,088,074; currants (29 million lb.), figs, lemons, oranges, plums and prunes (70 million lb.), preserved fruits, raisins, almonds, filberts, and walnuts falling into this category. The value of orchard products in the United States in 1880 was $50,876,154; and the same year the value of canned and preserved fruits prepared for sale in the States was $17,600,000, besides very large quantities similarly preserved for home use.

Fruit-pigeon (*Carpophaga*), a genus of pigeons, including about fifty species, distributed over the whole Australian and Oriental regions,

but much more abundant in the former. They live in forests, are well adapted for arboreal life, and feed on fruits. The gape is wide; the colouring of the plumage brilliant. The term fruit-pigeon is also extended to members of other genera—Treron, Alectrœnas, &c. See PIGEON.

Fruit-pigeon (*Carpophaga oceanica*).

Frumentius, ST, apostle of Ethiopia and the Abyssinians, born in Phœnicia towards the beginning of the 4th century. At a very early age he and another youth, named Ædesius, accompanied their uncle Meropius on a voyage undertaken for mercantile purposes, and they landed on the coast of Abyssinia or Ethiopia to procure fresh water; but the savage inhabitants made an onslaught upon them, and murdered Meropius and the whole crew, sparing only the two boys. They were taken as slaves into the service of the king, and made themselves so beloved that Ædesius was soon raised to the office of cupbearer, while Frumentius became the king's private secretary and instructor to the young prince, obtaining great influence in the administration of the state affairs. He aided the Christian merchants who sought these parts in founding a church, and gradually paved the way for the formal introduction of the new creed. In 326 he went to Alexandria, and was by Athanasius consecrated Bishop of Axum. The new bishop repaired to Abyssinia, and succeeded in proselytising large numbers. He is also supposed to have translated the Bible into Ethiopian (see ETHIOPIA). Frumentius died about 360.

Frumenty, or FURMETY (Lat. *frumentum*, 'wheat'), an English dish made of whole wheat or rice boiled in milk and seasoned.

Frundsberg, GEORG VON, the great leader of the German landsknechte during the Italian wars of the emperors Maximilian and Charles V., was born in 1473 at Mindelheim in Swabia, and there he died in 1528. He fought in twenty pitched battles, besides sieges and skirmishes without number; and the victory of Pavia (1525) was largely due to him. Two years later he was marching on Rome with the Constable de Bourbon, when a mutiny of his soldiers brought on a stroke of apoplexy. See monographs by Barthold (1833) and Heilmann (1868).

Frustum, in Geometry, is the part of a solid next the base, left on cutting off the top by a plane parallel to the base. The frustum of a sphere or spheroid, however, is any part of these solids comprised between two circular sections; and the *middle* frustum of a sphere is that whose ends are equal circles, having the centre of the sphere in the middle of it, and equally distant from both ends.

Fry, ELIZABETH, born May 21, 1780, was the third daughter of John Gurney, Esq., of Earlham Hall, near Norwich, a rich banker, and a member of the Society of Friends. Her mother died when she was twelve years old, leaving four sons and seven daughters. The sisters grew up attractive and original. They dressed gaily, and sang and danced. Till Elizabeth was eighteen she had no decided religious opinions. In February 1798 a discourse she heard in the Friends' meeting-house at Norwich by William Savery, an American Friend, made a deep impression on her, and led her to wish to become a 'plain Friend.' From this time her natural loving care for others was greater than before. She worked much among the poor, and began a school for poor children, which she managed entirely herself, even when the number of scholars increased to more than seventy. In August 1800 she married Joseph Fry, of Plashet, Essex, then engaged in extensive business with his brother in London. She lived with her husband in his house of business, St Mildred's Court, City of London, till 1809, when, on the death of her father-in-law, she removed to Plashet. Five children were born to her in London, and six more at Plashet. In 1810 she became a preacher among the Friends. In February 1813 she visited Newgate for the first time, and saw 300 women, tried and untried, with their numerous children, without employment, in an almost lawless state, crowded together in rags and dirt, with no bedding, and nothing but the floor to sleep on. She could do no more then than supply them with clothes, but, within a few years, by her efforts, a school and a manufactory were established in the prison, a Ladies' Association was formed for 'the improvement of the female prisoners,' religious instruction was regularly given to them, a matron was appointed, and the women willingly submitted to rules for their well-being. Prison reform now became one great object of Mrs Fry's life. She visited prisons in different parts of the kingdom and on the Continent, and introduced many improvements in their management and discipline. She also did a great deal to improve the condition of the female convicts sentenced to transportation. Through her influence libraries were begun in the naval hospitals and the coastguard stations, and Bibles were supplied to them. She died at Ramsgate, October 12, 1845, and was buried at Barking, Essex. Mrs Fry was a true-hearted, loving woman, peculiarly gifted for the difficult work she had to do by her sympathy, her great power of understanding, quickness of perception, tact, and charm of manner. See the Life by her daughters (2 vols. 1847), and the shorter one by Mrs Pitman (1884).

Frying. See BOILING, COOKERY, FOOD.

Fryxell, ANDERS, a Swedish historian, was born 7th February 1795, at Hesselskog in Dalsland; studied at Upsala, took priest's orders in 1820, and in 1828 became rector of a gymnasium in Stockholm. From 1835 to 1847 he was parish priest of Sunna in Vermland, and from this latter year he devoted himself entirely to literary pursuits till his death at Stockholm, 21st March 1881. His reputation rests upon *Berättelser ur Svenska Historien* ('Narratives from Swedish History,' 46 vols. Stockh. 1832–80). These narratives, largely biographical in form, and distinguished by their impartial love of truth, soon obtained a wide popularity in Sweden. Parts of them have been translated into almost all European languages (Eng. trans. edited by Mary Howitt, 1844). Another work, *Conspiracies of the Swedish Aristocracy* (4 vols. Upsala, 1845–50), was intended as a reply to the accusations urged against that class by Geijer and others, and involved Fryxell in a keen controversy with the democratic liberal party in Sweden. Besides these works he wrote a *Contribution to the History of the Literature of Sweden* (9 vols. 1860–62). Fryxell also laboured, both by his own example and by the publication of a *Swedish Grammar*, to purify his native language from the parasitism of foreign words.

Fuad Pasha, MEHMED, a Turkish statesman and littérateur, was born at Constantinople, 17th January 1814. He was the son of the celebrated poet, Izzet-Mollah, and had already begun to make himself known as an author, when the exile of his father, who had fallen into disgrace with the Sultan Mahmud, compelled him to choose a profession. He studied medicine, and for some years was Admiralty physician, but in 1835 abruptly forsook medicine, and employed himself in the study of diplomacy, history, modern languages, the rights of nations, and political economy. In 1840 he became first secretary to the Turkish embassy at London, and in 1843 was at Madrid. It was almost impossible to believe him to be a Turk, he spoke French so marvellously well.. On his return to Constantinople he was appointed to discharge the functions of grand interpreter to the Porte, and in 1852 became minister of foreign affairs. On the question of the 'Holy Places,' Fuad Pasha, by his attitude, and by a brochure very hostile to the pretensions of Russia, gave great dissatisfaction to the czar. In 1855 he received the title of Pasha, and was again appointed minister of foreign affairs. From 1861 to 1866 he held the office of Grand Vizier. He died in 1869. To him especially it is said Turkey owes the hatti-sherif of 1856. See TURKEY.

Fuca, or JUAN DE FUCA, STRAIT, a passage separating Washington Territory from Vancouver Island, and connecting the Pacific Ocean with the Gulf of Georgia. It contains several islands, one of which, San Juan, became the subject of a dispute between Great Britain and the United States, the question being whether it was to be regarded as an appendage of Washington Territory or of British Columbia. In 1872 the emperor of Germany, as arbiter, decided that the line of boundary should be run through the Strait of Haro, west of San Juan, thus awarding that island to the United States; and it and several neighbouring islands now form a county of Washington Territory, with a population of 948.

Fû-chau. See FOOCHOW.

Fuchsia—named in 1703 by Plumier after Leonhard Fuchs (1501–66), who with Brunfels and Bock (see BOTANY) was one of the founders of German botany—a genus of Onagraceæ containing

a, Fuchsia Riccartoni; *b*, a garden variety.

about fifty species, small shrubs or trees, natives of the Pacific coast of South America, whence a few have ranged northwards to Central America, and others to New Zealand. The usually pendulous flowers are of characteristic appearance and often striking beauty; they are very easily propagated by cuttings and grow freely, especially near the seacoast. Some, notably *F. discolor* and *F. Riccartoni*, are capable of withstanding our winter so well that fuchsia-hedges are a common ornament of gardens on the west coast of Scotland. Others can be treated as herbaceous plants; and most if not indeed all will flower well in the open air during summer. Cultivators recommend keeping back plants, so that when planted out in May they shall only then begin to put out their leaves. The commonest species is usually known as *F. coccinea* (but is said to be only a variety of *F. globosa*, and this again of *F. macrostemma*, while the true *F. coccinea*, with nearly sessile leaves, is rare); *F. conica*, *corallina*, *fulgens*, *gracilis*, &c. are also well known, as well as the hardier species above named, while the florists' varieties and hybrids are innumerable. There are also many dwarf species of characteristic habits. The berries of many species are eaten with sugar in their native countries, and when they ripen are occasionally preserved even here. The wood of some species is also employed in South America as a black dye.

Fuchsine. See DYEING.

Fuchs's Soluble Glass. See GLASS, SOLUBLE.

Fucino, LAKE OF, or LAGO DI CELANO (ancient *Fucinus Lacus*), a lake of Italy, in the province of Aquila, with an area of 61 sq. m., is situated 2172 feet above sea-level. Being only 75 feet deep and having no constant outflow, it was subject to sudden risings, which on more than one occasion inundated the surrounding regions. To obviate this danger the Emperor Claudius cut a subterranean channel, nearly 3 miles in length, through the solid rock of Monte Salviano, 30,000 men being engaged in the work from 44 to 54 A.D. This tunnel, however, soon became obstructed and long remained so, notwithstanding various attempts to clear it. As the lake had been steadily rising from 1783, a new canal was made (1852–62) by the Swiss engineer De Montricher. By 1875 the lake was dry; it is now under cultivation.

Fucus, the generic name of the various species of brown sea-wrack which form the main vegetation of rocky shores between tide-marks. Commonest of all upon European coasts (save in the Mediterranean), and abundant also in the North Pacific, is *F. vesiculosus* (Bladderweed, Black Tang, Seaware, Kelp-ware, &c.), easily distinguished by its entire edges and paired air-vesicles. In scarcity of better fodder, oxen, sheep, and deer will eat it from the rocks, and in North Europe it is sometimes boiled for hogs with a little coarse flour. On account of the very large proportion of ash (up to 23 per cent. of the dry weight), it forms a valuable manure, and, although very imperfectly utilised in most places, is regularly harvested as 'varec' or 'vraic' by the farmers of the Channel Isles and their kinsmen of the adjacent mainland. The chemical composition also made it the staple of the industry of kelp-burning (see KELP), once so important as a source of raw material to the soap-boiler and glass-maker. Even more esteemed for these purposes, although unfortunately abounding nearer low-water mark, was the kindred *F. nodosus* (Knobbed Wrack) with its solitary air-vesicles in the line of the absent midrib. *F. serratus* (Black Wrack), also very common and easily recognised by its serrated fronds without air-vesicles, was least valued. With these are gathered other less common species, as well as the Laminaria (see TANGLE), exposed by the lowest tides. Besides manure, the only direct chemical utilisation of the Fuci is for the preparation of iodine; and the important proportion of iodine present justifies their ancient medicinal repute in the treatment of scrofulous diseases, the

Quercus marina of ancient pharmacy being *F. serratus*, and the *Æthiops vegetabilis* the charred residue of this and its allies. An alcoholic extract is also frequently advertised for the treatment of corpulence.

The genus Fucus and a few closely allied genera (e.g. Fucodium, Himanthalia, Cystoseira, and notably Sargassum, specially described under GULF-WEED), form the family Fucaceæ, which are the highest, and with the allied Laminariaceæ (see TANGLE), also the most familiar representatives of the large alliance of brown seaweeds (see SEAWEEDS). The vegetative body is usually a thallus, yet in Sargassum, &c., a distinction of this into stem and leaves is very complete. The branching of Fucus is dichotomous in one plane. Of the inner or medullary cells of the thallus, the outer wall becomes mucilaginous, while the less superficial of the rind cells develop filaments which grow inwards, so surrounding the inner cells within a network of filaments. The bladders are formed by the simple separation of portions of the tissue, the cavities becoming *distended by air. A sexual multiplication may be* said to be absent, but sexual reproduction is easily observed. A large area at the end of the frond becomes covered with small depressions, which are overgrown until they are spherical flasks with only a minute opening on the surface. The cells lining this flask or *conceptacle* proceed to divide, and many form barren cellular filaments which, however, instead of turning inwards, as in vegetative growth, grow into the cavity of the flask or even project beyond it as a tuft of hairs. But many are arrested in division while still only two-celled, and the upper of these cells enlarges greatly. In some forms (Cystoseira, Himanthalia) this becomes the ovum, but in others its contents divide into two, four, or in Fucus eight ova; hence it is termed the oogonium. Other filaments again not only lengthen, but branch freely. Their terminal cells become antheridia—i.e. their protoplasm divides into a multitude of spermatozoids. Fertilisation takes place when the ripe fertile fronds are left bare by the tide, the change of specific gravity through evaporation doubtless being of importance in aiding the escape of the sexual products. The outer membrane of the oogonium, like that of a medullary cell, becomes mucilaginous and gives way, and the groups of eight ova, still, however, enclosed within the inner wall, escape from the conceptacle; the antheridia, too, break off and escape to the opening of the conceptacle (perhaps helped by the slight contraction of the volume of this which evaporation must tend to produce). When the tide returns, both ova and spermatozoids break completely free and fertilisation takes place. Cross-fertilisation, always possible even where, as in *F. platycarpus*, the same conceptacle develops ova and spermatozoa, becomes perfect in the more familiar species, of which the greater prevalence thus becomes more intelligible. The fertilised ovum soon develops a wall, becomes attached, and proceeds to divide and lengthen, soon forming a root-like attachment at one end, a growing point at the other. See SEAWEEDS; also special articles above mentioned.

Fuego, TIERRA DEL. See TIERRA DEL FUEGO.

Fuel. The chief mode of artificially producing that condition of matter which is called heat is by burning certain substances in air. These substances contain carbon and hydrogen, which during the chemical change implied by burning unite with the atmospheric oxygen, and as the temperature rises emit light as well as heat. Since these two elements are very widely distributed in nature, the classification of all the compounds which may be termed fuels is somewhat difficult. After using wood for long ages men at last laid the mineral kingdom under requisition, but the fuels thence derived were soon recognised to be undoubtedly of vegetable origin. Some writers include all these under the term natural, and distinguish such derivatives as coke, charcoal, and combustible gases as artificial. Popularly, fuels are a large class of compounds, all of vegetable origin except the animal oils and fats, which produce heat and light when raised to 'kindling temperature.' Thus, besides coal and coke, wood and charcoal, and peat or turf, we must reckon tallow, wax, alcohol, coal and other gases, petroleum, creasote or 'dead-oil,' and others as fuels. To be exhaustive, we should further refer to a sub-class called 'patent' fuels.

The ordinary solid fuels fall under two heads: those containing water in a large proportion—e.g. wood, turf, and most coals—and therefore producing, when burned, hydrogen as well as carbon; and secondly, those which are purely carbonaceous—coke, charcoal, and anthracite. In recent times, *since metallurgy has assumed such proportions in* all countries, and especially since the application of steam-power, the coking of coal has been more and more perfected, in order to concentrate the carbon and present a fuel capable of producing a higher temperature. Wood as a fuel is either light and soft, as deal, or heavy and hard, as oak; but neither kind is now applied in metal-working, unless in the concentrated form of charcoal. Wood contains so large a proportion of water as to reduce its heat-giving quality both in quantity and intensity, and contains less than half its weight of carbon (see table).

Charcoal is formed by condensing the carbon of wood and expelling the hydrogen and oxygen, just as coke is a concentration of coal by an analogous process. When the wood has been packed and so closed in as to prevent access of air, by raising the whole to a temperature of about 300°, the watery and gaseous particles are entirely expelled, and a mass of almost pure carbon remains. Similarly from coal we have coke, prepared by 'dry distillation' or imperfect combustion, so as to retain the carbonaceous part in a concentrated state and set free the volatile ingredients and part of the sulphur. A special property of coke for metallurgy, as compared with coal, is that, when exposed to high temperatures as in iron-blast furnaces, it does not become pasty.

Turf or peat is an agglomeration of decayed vegetable matter, such as is frequently found on the sites of ancient forests. It is remarked that no instance of its formation occurs within the tropics; though Lyell describes the Great Dismal Swamp between Virginia and North Carolina to be a mass of black peat-like matter, 15 feet deep. Some peaty sediment has also been noted in a Cashmere lake. From holding so small a percentage of carbon, turf is of little use in the arts; but in Bavaria it has been utilised for locomotive engines after being compressed into bricks, and in some districts it has been converted into a species of charcoal.

Superior to the peat fuels, though still inferior in carbon to coal proper, are the lignites or brown coal, which occur in geological deposits of more recent formation than the true coal-measures. The lignites contain a larger proportion of water than coals properly so termed; and are of so many varieties as gradually to pass into the bituminous class, which are known by their smoky flame and derive their name, not from any bitumen in their composition, but from the well-known tars which they produce. With the bituminous must be reckoned the 'coking coal' and the 'cannel (i.e.

candle) coal.' The last-mentioned variety, moreover, includes the Edinburgh 'parrot coal' (so named from its crackling) and the 'horn coal' of South Wales, which is characterised by a smell like that of burnt horn. At the head of this class of fuels is the anthracite coal, holding over 90 per cent. of carbon, and therefore of special value for some purposes in metallurgy and otherwise. Anthracite is very compact, somewhat brittle, and does not stain the fingers like ordinary coal.

For comparing as fuels some leading types of coals the following table—which is an abstract from various returns—will be of use, presenting the percentage of carbon, of hydrogen, and the ash left after combustion:

Fuel.	Carbon.	Hydrogen.	Ash.
Welsh coal	91·3	3·3	1·6
"	90·7	3·9	·9
	89·2	2·4	4·7
	86·3	5·2	1·4
	83·0	3·3	6·1
	82·6	5·7	2·6
	81·2	3·8	4·5
Stanley	75·4	5·2	2·3
	73·4	2·9	5·0
	69·1	5·2	3·0
	78·1	9·3	2·8
	57·2	5·9	5·0
	49·6	5·8	2·0

In primitive times the scarcity of wood in some parts of Egypt and India suggested the use as fuel of sun-dried cakes of the dung of camels and oxen. A similar practice exists to-day in the trackless steppes of Central Asia; and so, too, in various countries of Europe much refuse, especially of a vegetable nature, is utilised which in coal or wood producing districts is rejected as absolutely worthless. In eastern France, for example, and Germany all the spent bark from tanneries is formed into cakes for fuel, and estimated as worth about three-fourths the same weight of wood. Where coal is not found or cannot profitably be conveyed, the preservation of forests is of manifest importance; and in certain parts of Europe, for example, trees are systematically planted in hedgerows and otherwise to provide fuel. For the same reason pollarding is resorted to, the branches being regularly cut, and the trunk left to grow fresh fuel. The scientific world, with as good a reason as the primitive races, have recently found means to largely supplement the natural supply of vegetable and mineral fuels by fluid or gaseous substances. Thus, in smelting iron, for example, the carbonic oxide, which formerly was carried off in the smoke from the blast-furnace, is now sometimes collected and conveyed in pipes to be utilised as fuel under steam-boilers. Natural gas has also been used to good purpose, notably in Pennsylvania, United States, where in several instances it has been transferred for several miles for heating furnaces. In the same district petroleum is a recognised liquid fuel, as well as naphtha, its derivative. Another liquid fuel is creasote-oil, derived from coal-tar, which is reported to possess, weight for weight, at least twice the power of coal for raising steam. The United States chemists and metallurgists are agreed that not only is a 'higher, steadier, and more even heat' produced by liquid fuel, but that, for heating iron more especially, a smaller quantity and shorter time suffice to obtain the same results. Baku petroleum is used as fuel for locomotives and steamers in South-east Russia. See GAS.

Under this head we subjoin some figures from a report of a Royal Commission drawn up in 1871 by Professor Rankine. The first column (A) shows the quantity of heat units generated by the fuel; the second (B) the pounds of water heated from 60° to 212°, and then, of course, converted into steam; and the third column (C) gives the comparative temperature of the fire or flame:

Fuel.	A.	B.	C.
		15	4646
		15	4646
		15	4646
Creasote	16,626	13	4495
Coal	from 13,890 to 14,833	8·95 to 9·67	2500 2500

The three points noted in testing a fuel chemically are the intensity of the heat, the quantity of heat developed in combustion, and the luminosity. The last of these, however, affords but an imperfect measure of the temperature, because it is mainly due to the presence of solid particles. Instead of the second some writers use the term 'calorific power.' In ordinary coal combustion there are two steps of the process: (1) the carbon is separated from the hydrogen in light particles, which, unless burned, appear as soot or smoke; (2) the hydrogen becoming ignited heats up the carbon particles, which therefore appear as flame. For the complete combustion, therefore, of a typical hydrocarbon we require not only air in sufficient quantity, but also intensity of heat above the fuel. In a good furnace the supply of coal should by mechanical contrivance be rendered as regular and uniform as that of air; and the body of the furnace should be so protected from the boiler surface and other cooling agents as to steadily maintain a temperature sufficient for thorough ignition of the flame.

What are called 'patent fuels' arise mainly from the desire to utilise the refuse arising from the production or wasteful use of coal. Such artificial fuel, however, is by no means an entirely modern device, since the Chinese have for ages been accustomed to mix coal-dust with clay and bitumen, so much so as to constitute a large branch of industry. The most common form of 'patent fuel' is a mixture of the small coal which accumulates at the pit mouths with sand, marl, or clay, or of some bituminous or resinous substance with sawdust. A second kind has dried and compressed peat as its basis, and is sold in the form of a dense brown solid. Another is an attempt to utilise small coke and the refuse 'breeze,' which is well known in charcoal burning. The 'charbon de Paris' is a combination of the dust of anthracite charcoal and similar refuse with coal-tar, so as to form a paste and be moulded into small cylinders of about 4 inches in length. Briquettes (q.v.) are compounds of waste coal-dust and pitch.

See Report of Royal Commission on the Coal of the United Kingdom (1871); Report on the Coals suited to the Steam Navy (1848); Rumford's Works, vols. ii., iii.; and Williams, *Fuel: its Combustion and Economy* (3d ed. 1886).

Fuente Alamo, a town of Spain, 20 miles S. of Murcia. Pop. 7900.

Fuente Ovejuna, a small walled town of Spain, 45 miles NW. of Cordova. Pop. 7937.

Fuenterrabia. See FONTARABIA.

Fuentes de Oñoro, a small village of Salamanca, Spain, on the Portuguese frontier, 15 miles WSW. of Ciudad Rodrigo, was the scene of an important battle of the Peninsular war on the 5th May 1811, when Wellington defeated Massena. The English lost 2000, the French 5000.

Fuero (Span.; Portuguese, *foral, foraes;* Galician, *foro;* Gascoun, *fors;* Lat. *forum*), a term used in different senses. (1) The title of a law code, *Fuero Juzgo,* the so-called legislation of the Gothic kings of Spain; *Fuero Real,* &c. (2) The municipal charters of privileges granted by kings, lords, and monastic bodies to inhabitants of towns—Leon (1020), Najera (1035), Sahagun (1085), &c., especially to towns deserted or recaptured from the Moors, or those used for frontier defence—e.g. Oloron, in Béarn (1080). Sometimes these charters were offered especially to foreigners, *Fueros Francos.*

Charters granted to attract settlers and those given by the royal power must be distinguished from others; fueros based on legislation long antecedent and flourishing, e.g. those of Lerida (1228), were compiled 'de statutis scriptis et non scriptis, et moribus et usaticis, etiam legibus Goticis et Romanis.' The term is also applied to the capitulations granted to Moors and Jews, the oldest of which is that of Huesca (1089). (3) Modes and tenures of property, succession, &c., nearly equivalent to the French *coutumes, usages*, or customary law—e.g. *El Foro de Galicia, Los Fors et Costumas de Béarn*, &c. The date of the writing down of this class of fueros is no measure at all of their real antiquity. (4) The whole body of legislation and the constitution of certain practically autonomous states and communities in northern Spain and south-western France—e.g. the fueros of the provinc[illegible]y, Alava, and Guipuzcoa; in a autonomy, the fueros of Navarre; and of a still less, those of Aragon, of Béarn, &c.

Groups 1 and 2 we may pass over to be studied in the documents special to each case. Group 3 is of far greater importance. In it we find traces of customs and tenures which have long disappeared from other codes, and the origin of which belongs to the tribal or pastoral condition of society. There are also anomalies not to be fully explained by our present knowledge, as the *derecho consuetudinario* of Upper Aragon, identical with the *house community* of the southern Slavs, though there is no apparent racial or other connection with the Slavs. In the chief region of these fueros, from the borders of Catalonia to Santander, there is no trace in the foral legislation of Gothic or Teutonic influence. Within the states of class 4, and outside them in the same region, were various kinds of autonomies, or local self-governments, municipalities, federations of towns, valleys, districts, communes, each with its own special fuero. The term *republicas, republiques* was often applied to these communities in transactions between themselves, as also by the kings of Spain in the Cortes of Navarre, to the Basque provinces, and to the separate valleys and communes down to the French Revolution.

The chief provision of the fueros, whereby these communities preserved their autonomy, was a freely elected legislative body, chosen according to the methods customary in each district, meeting at a given place at given times. This assembly was called the *junta* in the separate Basque provinces, with the Junta General meeting at the oak of Guernica in Biscay, Cortes in Navarre, Etats in Béarn, Bilzaar in the Labourd, Cort, Tilhabet, &c., in the lesser communities. In these assemblies the right of taxation was jealously guarded. The contribution to the king was the last vote taken, after all grievances had been redressed and petitions heard, and then only as a voluntary gift. The repartition of taxes to individuals was in the hands of each separate community. Freedom of commerce existed, with few or no customs-duties. The levy and command of the military forces of the states remained in their own power; the number of soldiers was fixed, with no compulsion to serve beyond the confines of the province, unless with consent of the juntas, &c., and for payment guaranteed. This did not prevent voluntary service of individuals. Jurisdiction of all kinds was in their own power. In all matters relating to property, land-tenure, inheritance, &c., even in particular families, the local customs or fueros overrode both the general fueros and the general laws either of Spain or of France; only the nobles or Infanzones were subject to these. Under this constitution the Basque provinces flourished, and supported the largest population per square mile in Spain, with the exception of Galicia, until the middle of the present century. On the death of Ferdinand VII. (1833), the liberal regency hesitated to confirm the fueros. Don Carlos, the late king's brother, raised the standard of revolt. The seven years' war was ended by the Convention of Vergara, 30th August 1839, and Isabella confirmed the fueros. Don Carlos, grandson of the first, headed the second Carlist war (1872–76). It resulted in the loss of the fueros of the provinces, which will gradually become assimilated to the rest of Spain. In France, save for the management of the communal property in some parishes, the *fors* were swept away by the Revolution and the Code Napoleon, though some traces still remain in the habits and customs of the people.

See the article BASQUES, and the following special books: Marichalar y Manrique, *Historia de la Legislacion Civil en España* (vol. ii. 2d ed. Madrid, 1868); Muñozy Rivero, *Coleccion de Fueros Municipales* (Madrid, 1847); *Catalogo de Fueros y Cartas-Pueblas de España* (R. Academia de Historia, Madrid, 1852); Mazure et Hatoulet, *Fors de Béarn* (Pau, 1842); G. B. de Lagrèze, *La Navarre Française* (Paris, 1881); the last editions of the separate *Fueros* published in each province at Zaragoza, Pamplona, Tolosa, Bilbao.

Fugger, a remarkable Swabian family, which rising by industry and commerce founded lines of counts and even princes. The ancestor of the family was John Fugger, master-weaver, born in 1368 at Graben, near Augsburg. His eldest son, John Fugger, acquired by marriage, in 1370, the freedom of Augsburg; he died in 1409. But the real founder of the house was John's second son, Jacob Fugger, who died in 1469, and was the first of the Fuggers that had a house in Augsburg, and carried on an already extensive commerce. Of his seven sons, three, Ulrich, George, and Jacob II., by means of industry, ability, and integrity, extended their business to an extraordinary degree, and laid the foundation for the palmy days of the family. They married into the noblest houses, and were raised by the Emperor Maximilian to the rank of nobles. The emperor mortgaged to them, for 10,000 gold guldens, the county of Kirchberg and the lordship of Weissenhorn. Ulrich Fugger (1441–1510) devoted himself specially to commerce with Austria. Jacob Fugger (1459–1525) farmed the mines in Tyrol, accumulating immense wealth; he lent enormous sums to various potentates, and built the magnificent castle of Fuggerau, in Tyrol.

But it was under Charles V. that the house attained its greatest splendour. Jacob having died childless, and the family of Ulrich being also extinct, the fortunes and splendour of the house rested on the sons of George Fugger, who died in 1506. His two younger sons, Raimund and Antony, carried on the business, and became the founders of the two chief and still flourishing lines of the house of Fugger. The two brothers were zealous Catholics, and with their wealth supported Eck in his opposition to Luther. During the diet held by Charles V. at Augsburg in 1530 the emperor lived in Antony Fugger's splendid house in the Wine Market. On this occasion he raised both brothers to the rank of counts, and invested them with the still mortgaged properties of Kirchberg and Weissenhorn; and a letter under the imperial seal conferred on them the rights of princes. The Emperor Ferdinand II. raised the splendour of the house of Fugger still higher by conferring great additional privileges on the two oldest of the family, Counts John and Jerome. The Fuggers continued still as nobles to carry on their commerce, and further increased their immense wealth. They attained the highest posts in the empire, and several princely houses prided

themselves on their alliance with the house of Fugger. They possessed the most extensive libraries and art collections, maintained painters and musicians, and liberally encouraged art and science. Their houses and gardens were masterpieces of the architecture and taste of the times. While thus indulging in splendour, they were not less bent on doing good. Jacob (the second of the name) bought houses in one of the suburbs of Augsburg, pulled them down, and built 108 smaller houses (called the 'Fuggerei'), which he let to poor citizens at a low rent. The race is still continued in the two principal lines of Raimund and Antony, besides collateral branches. The domains are chiefly in Bavaria. See Kleinschmidt, *Augsburg, Nürnberg, und ihre Handelsfürsten* (1881).

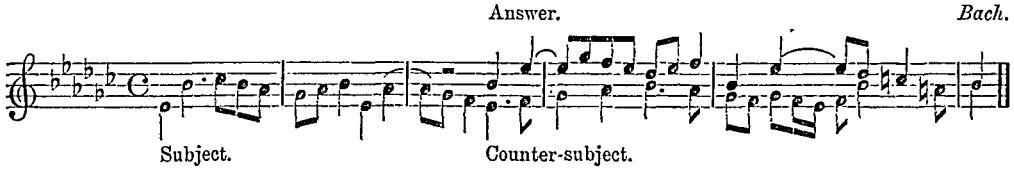
Fugitation, the Scottish equivalent of Outlawry (q.v.) in England.

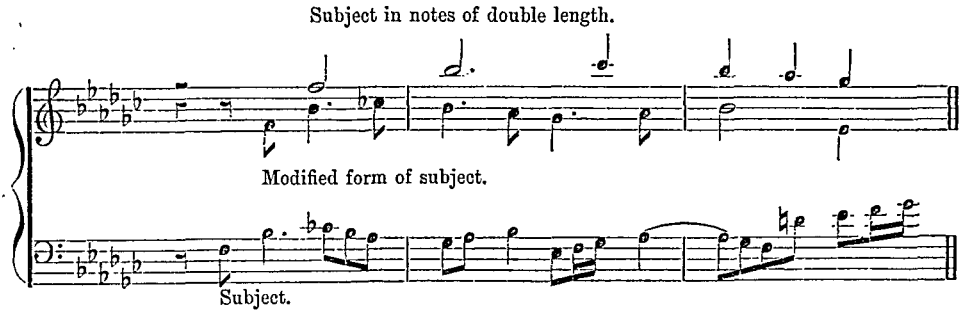
Fugitive Slave Law. The constitution of the United States of America having recognised slavery, or 'service,' as it was termed, provided that persons held to service or labour in one state, under the laws thereof, and escaping into another, should be delivered up, on claim of the party to whom such service or labour might be due. An act passed by congress in 1793, providing for the reclamation of fugitives, was superseded by a more stringent act in 1850, containing many obnoxious provisions; a larger fee, for instance, was paid to the judicial officer when the person arrested was adjudged to be a slave than when he was declared free; and all citizens were required, when called upon, to render the officers personal assistance in the performance of their duties. Any assistance rendered to a fugitive, or obstruction offered to his arrest, was penal, and many persons were remanded under the act; but the increased hostility to slavery which it engendered actually led to assistance being given in a larger number of escapes than ever before, mainly through the organisation known as the 'underground railroad.' The act was repealed after the outbreak of the civil war; and, since slavery has been abolished, the constitutional provision has lost all importance.

Fugleman (Ger. *flügelmann*, 'a man placed at the end of a file;' from *flügel*, 'a wing'), an intelligent soldier posted in front of a line of men at drill, to give the time and an example of the motions in the manual exercises.

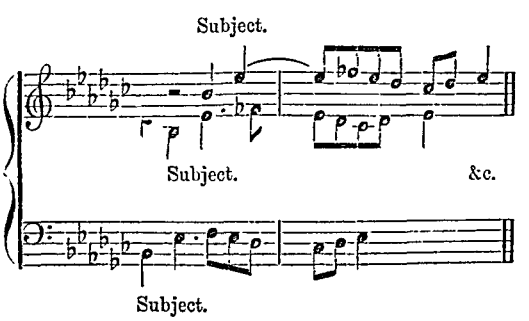
Fugue is the form of musical composition in which all devices of counterpoint, or the art of combining independent ideas in music, find their most fitting use. The laws which govern it are as strict as numerous, and can only be very generally summarised. The 'subject' chosen as the basis of the composition should present a complete and distinct individuality, which to be readily recognised in its permutations should be well marked. It is given out by any one part, and immediately taken up by a second—its follower or *pursuer* (*fuga*, 'a flight'). This 'answer,' as it is called, is identical in form with the subject, or slightly modified in accordance with a rule which requires the upper division of the octave (G to C in the scale of C) to correspond to and 'answer' the lower (C to G). During the

'answer' the first part supplies an accompaniment or 'counter-subject,' which should be a figure of contrasted character, and interesting enough to enable





it to play its important part in the subsequent development. A third part joins by enouncing the subject, while a fourth, fifth, even a sixth part may be added, entering alternately with the answer, subject, and answer. The introduction of all the parts constitutes the first section, and is called the 'exposition.' During the development, which finds its place in the second section, the composer should show his skill in the use of imitation, canon, &c., and so arrange his material that the intricacy and interest gradually increase. Before the conclusion of the fugue he should present a *stretto*, in which the parts press on and overlap each other in their enunciations of the subject.



A 'pedal point'—a bass note held while the upper parts move in as skilful a complication as the composer can devise—usually precedes the final cadence. 'Episodes,' or matter connected or in character with the subject, may be introduced throughout the development to afford variety, but these must be short, and must not be allowed to distract the attention. When two or three subjects are treated simultaneously the fugue is called double or triple.

Formulated early in the history of modern music, the vocal fugue was elaborated during the 'golden age of counterpoint' in the end of the 16th century. A new world was opened to it by Frescobaldi, who freed it from the limitations of the human voice, and first wrote instrumental fugues. Sebastian Bach, in his vocal and instrumental fugues, shows a genius which has never been rivalled. Mendelssohn was peculiarly gifted in this branch of composition, and many vocal fugues with most brilliant and effective instrumental accompaniments are to be found in his oratorios.

Although fugues in composition and performance have always been more or less 'caviare to the general,' the opinion of sound musicians in the present as well as the past is unanimous as to their value, interest, and the beauty of those by the standard writers. Details in construction have continually changed and developed during the three centuries of the existence of fugues, and text-books are as numerous as teachers. Those by Sir F. Gore Ouseley (prescribed at Oxford University); Jadassohn and his predecessor, Richter, of Leipzig Conservatorium; and Dr Higgs' Primer are probably of more use to-day than the famous works of Albrechtsberger, Reicha, &c. Bach's *Art of Fugue* is a collection of fifteen fugues, four canons, &c. on one subject—a practical and invaluable illustration from the hand of the greatest master of counterpoint. See article 'Fugue' in Stainer and Barrett's *Dictionary of Musical Terms.*

Fühnen. See FÜNEN.

Fuji-san. See FUSIYAMA.

Fu-kian, or FÛ-CHIEN, an eastern maritime province of China (q.v.).

Fulahs, also FULBE, FÉLLANI, FELLÁTA, and PEULHS, a people of the Soudan, extending from Senegal in the west to Darfur in the east, and from Timbuktu and Haussa in the north to Joruba and Adamawa in the south. Their ethnographic relations are not yet definitively settled, some allying them with the Soudan negroes, some with the Nuba of the Nile region, others regarding them as an isolated race. We first read of them about the beginning of the 14th century in Ahmed Bábá's *History of Soudan.* After that century large bands of them left their home on the confines of Senegambia—i.e. Futa-Jallon—and, proceeding eastwards, spread themselves over the greater portion of the Soudan. There appear to be two distinct branches, a dark-skinned division, having its centre in Bornu and Adamawa, and an olive-skinned division, occurring chiefly in Sókoto. All are strong and well-built, with long hair and regular Caucasian features. They are very intelligent, have a frank, free bearing, are trustworthy, possess considerable self-respect and decision of character, and are devoutly religious. They probably number 7 to 8 millions altogether. The Fulahs are a conquering *race,* not a homogeneous *nation;* and have founded several kingdoms throughout central and southern Soudan, as those of Sókoto, Gando, Massina, and Adamawa. The numerous tribes belonging to their stock are generally divided into four groups or families—the Jel, the B'aá, the Só, and the Berî. Most of them became converted to Mohammedanism about the middle of the 18th century; in 1802, under the Imám Othman, they commenced a religious war on the surrounding pagans, which terminated in the establishment of the great Fulah empire of Sókoto. The Fulahs are an industrious people: they practise agriculture, rear cattle, and carry on trade; they also work iron and silver, manufacture with great neatness articles in wood and leather, and weave various durable fabrics. They have mosques and schools in almost all their towns. See Crozals, *Les Peulhs* (Paris, 1883).

Fulcrum, in Mechanics, is the prop or fixed point on which a lever moves. See LEVER.

Fulda, a town of the Prussian province of Hesse-Nassau, 67 miles NE. of Frankfort-on-the-Main by rail, and on the river Fulda, is an irregularly built old town, still partially surrounded by its ancient walls. It is principally celebrated for its Benedictine abbey, founded by St Boniface (q.v.), the 'Apostle of Germany,' in the 8th century, which subsequently became a great centre of missionary enterprise as well as a notable seat of theological learning. Towards the end of the 10th century its abbot was made primate of all the abbeys of Germany. Having become corrupted and subject to many abuses, the monastery was thoroughly reformed in the early part of the 11th century by the introduction of fresh monks from Scotland. The cathedral, six times destroyed by fire, was rebuilt in 1704–12 on the plan of St Peter's at Rome. It is 324 feet long, and covers the crypt of St Boniface. The Romanesque church of St Michael (822) was restored in 1854. In the library are MSS. of Boniface's Gospels, besides other valuable MSS. and early printed books. The town has manufactures of various textiles, with dyeing, tanning, and the making of wax candles. Pop. (1875) 10,799; (1885) 12,226. Fulda, which owed its existence to the abbey, was created a town in 1208, and from the 16th century onwards had a very eventful history, being taken in the Peasants' War, the Thirty Years' War, and the Seven Years' War. From 1734 to 1804 it possessed a university. During the *Kulturkampf* it was one of the strongholds of the German Ultramontane party. See works by Gegenbaur (1874) and Schneider (1881).

Fulgurites (Lat. *fulgur,* 'lightning'), tubes due to the action of lightning. They have been most frequently observed in loose sandhills, but have often been detected also in more compact rock. They are formed by the actual fusion of the materials through which the lightning passes. The internal surface of the tubes met with in sandhills is completely vitrified, glossy, and smooth—the thickness of the wall varying from $\frac{1}{20}$th to $\frac{1}{10}$th of an inch, while the diameter of the tubes ranges up to $2\frac{1}{2}$ inches. They usually, but not always, descend vertically from the surface, sometimes dividing and subdividing, and rapidly narrowing downwards till they disappear. Fulgurites have often been detected on mountain-tops. In some cases the rocks attacked by lightning have the appearance of being covered with a black scoriaceous plaster, which looks as if it had 'run' or dripped. In other cases the rocks are described as being drilled—the holes produced by the lightning being lined internally with dark glassy substance. Fulgurites were first observed in 1711 by the pastor Herman, at Massel, in Silesia, and have since been found in many places; but their origin was first pointed out by Dr Hentzen in 1805.

Fulham, formerly a village, but now a suburb of London, in the south of Middlesex, on the left bank of the Thames, $4\frac{1}{2}$ miles SW. of Charing Cross. Here since 1141 has been the palace of the bishops of London, but the present building is

mostly not more than a century old. The church is ancient, and contains the tombs of many of the bishops. *Fulham* also has memories of Bodley, Florio, Richardson, Hallam, Crotch, and Albert Smith.

Fulica. See COOT.

Fuligula. See POCHARD.

Fuller, ANDREW, an eminent Baptist theologian and controversialist, was born, the son of a small farmer, at Wicken, Cambridgeshire, February 6, 1754. He had his education at Soham free school, but at an early age had to turn to farm-work. In his seventeenth year he became a member of a Baptist church at Soham, and soon began to speak with such acceptance that in 1775 he was chosen pastor of a congregation there. His small stipend of £21 per annum he endeavoured to increase by keeping, first a small shop, and then a school. In 1782 he removed to a pastorate at Kettering, in Northamptonshire. His treatise, *The Gospel worthy of all Acceptation* (1784), involved him in a warm controversy with the ultra-Calvinists, but showed him already a theologian of rare sagacity and insight, and still rarer fearlessness and sincerity. On the formation in 1792 of the Baptist Missionary Society by Dr Carey and others, he was appointed its secretary, and he devoted henceforward the whole energies of his life to its affairs. His controversial treatise, *The Calvinistic and Socinian Systems examined and compared as to their Moral Tendency* (1793), was attacked by Dr Toulmin and Mr Kentish; but Fuller replied vigorously in his *Socinianism Indefensible* (1797). Other works are *The Gospel its own Witness* (1797), an onslaught on Deism, and *Expository Discourse on the Book of Genesis* (1806), besides a multitude of single sermons and pamphlets. He died May 7, 1815. His complete works were collected in 1831, and re-issued in 1845 with a memoir by his son.

Fuller, GEORGE, an American artist, was born in Deerfield, Massachusetts, in 1822. As early as 1857 his work attracted attention, and during the last years of his life his pictures were warmly admired by many for their richness of tone and peculiar handling, though they never appealed to the popular taste. He died 21st March 1884. An exhibition of his paintings was held in Boston in that year, and a costly memorial work on his life and genius was published there in 1887.

Fuller, SARAH MARGARET, MARCHIONESS OSSOLI, author, was born at Cambridgeport, Massachusetts, May 23, 1810. She received much of her early education from her father, Timothy Fuller, a hard-working lawyer and congressman, after whose death (1835), intestate and insolvent, she assisted her family by school and private teaching. In Boston the leaders of the transcendental movement were her intimate friends; here she edited *The Dial*, translated from the German, and wrote *Summer on the Lakes* (1843). In 1844 she published *Woman in the Nineteenth Century*, and in the same year she proceeded to New York, on the invitation of Horace Greeley, then editor of the *Tribune*, and contributed to that journal a series of miscellaneous articles, which afterwards appeared in a collected form as *Papers on Literature and Art* (1846). In 1846 she went to Europe, where she made the acquaintance of many eminent people; and in 1847, at Rome, she met the Marquis Ossoli, to whom she was married in December of that year. She entered with enthusiasm into the struggle for Italian independence. In 1849, during the siege of Rome, she took the charge of a hospital; and on the capture of the city by the French she and her husband, after a period of hiding in the Abruzzi, and a few months at Florence, sailed with their infant from Leghorn for America, May 17, 1850. The vessel was driven on the shore of Fire Island, near New York, by a violent gale in the early morning of July 16; the child's body was found on the beach, but nothing was ever seen aft[illegible] Fuller or her husband. Her [illegible] memoirs by Emerson, Clarke, and Channing, appeared in 1852 (new ed. 1884); there are also lives by Julia Ward Howe (1883) and T. W. Higginson (Boston, 1884, 'American Men of Letters' series).

Fuller, THOMAS, divine, historian, and wit, was born in 1608 at Aldwincle St Peter's, Northamptonshire, elder son of the painful preacher, its rector and prebendary of Sarum, and of his wife, Judith Davenant. At his baptism (June 19) his godfathers were his two uncles, Dr Davenant, president of Queens' College, Cambridge, and Dr Townson, both of whom became in succession bishops of Salisbury. The boy early showed striking promise, and was in 1621 entered at Queens' College, Cambridge, where he graduated B.A. in 1625, and M.A. in due course three years later. Being unaccountably passed over in an election of fellows of his college, he was transferred in 1628 to Sidney Sussex College, and in 1630 received from Corpus Christi College the curacy of St Benet's, where he preached those *Lectures on the Book of Job* which he published in 1654. Next year his uncle gave him a prebend in Salisbury, in 1634 he was appointed to the rectory of Broadwinsor in Dorsetshire, and in 1635 he proceeded B.D. Already in 1631 he had published his first work, an ingenious but indifferent poem of 124 seven-lined stanzas, in three parts, entitled *David's Heinous Sin, Hearty Repentance, and Heavy Punishment;* and here he fulfilled faithfully the duties of a parish priest, married happily, and compiled his first ambitious work, the characteristically bright, vigorous, and quaint *History of the Holy War* (1639), embracing the story of the Crusades, as well as *The Holy and Prophane States* (1642), a unique collection of essays and characters, full of shrewdness, wisdom, and kindliness, lightened up on every page by the most unexpected humour, and by marvellous felicity of illustration. In 1640 Fuller sat as proctor for Bristol in the Convocation of Canterbury, and was one of the select committee appointed to draw up canons for the better government of the church. In the same year he published his *Joseph's parti-coloured Coat*, a comment on 1 Cor. xi. 18–30, with eight sermons full of the true Fuller flavour. Soon after he removed to London to become an exceedingly popular lecturer at the chapel of St Mary Savoy. In the exercise of his function he strove to allay the bitterness of party-feeling, but when the inevitable war broke out he adhered with fearless firmness to the royal cause, and shared in its reverses. Yet his characteristic moderation of tone offended the more hot-headed among the royalists, who misread his temperance into lukewarmness. He saw active service as chaplain to Hopton's men, and printed at Exeter in 1645 for their encouragement his *Good Thoughts in Bad Times*, a manual of fervid and devout short prayers and meditations, which was followed in 1647 by a second, *Better Thoughts in Worse Times*, and by his twenty-one short dialogues, *The Cause and Cure of a Wounded Conscience*. In the same year he began again to preach, at St Clement's, Eastcheap, but was soon suspended. His enforced leisure he gave with indomitable industry to study and compilation, being helped the while by patrons who knew his merit. One of the kindest of these was the Earl of Carlisle, who made him his chaplain, and presented him to the curacy of Waltham Abbey, which Fuller managed to keep throughout the troubles by passing the ordeal of Cromwell's Tryers. In 1650 he published his great survey of the Holy Land, full of maps and engravings, *A Pisgah-sight of Palestine*,

where for once geography became a peg whereon to hang alternate wit, wisdom, and edification. The very rocks and deserts are fertilised by his fancy, and not one of his 800 pages is dry or tedious. In 1651 appeared *Abel Redivivus*, a collection of religious biographies, of which Fuller himself wrote seven. His first wife had been already dead ten years when in 1651 he married a sister of Roper, Viscount Baltinglass. In 1655 he published in a folio volume his long-projected *Church History of Britain, from* the birth of Christ till the year 1648, divided into eleven books—a twelfth being a *History of the University of Cambridge*. The early books are divided into centuries, the later into sections, and in both the paragraphs are duly labelled and numbered with much ostentation of method, despite the perpetu[illegible] into heraldry and the like 'for . . . to divert the wearied reader.' Each book is dedicated to some noble patron, and a dedication is prefixed to every century or section. Altogether there are no fewer than 75 dedicatory epistles, addressed to 85 patrons or patronesses, of whom many, he tells us, 'invited themselves on purpose to encourage my endeavours.' The work was bitterly assailed by Dr Peter Heylin with no less than 237 several 'Animadversions' in his *Examen Historicum* (1659), as a rhapsody rather than a history, full of 'impertinencies' as well as errors, and still worse marred by partiality to Puritanism. Fuller at once replied in *The Appeal of Injured Innocence*, in which he gives his animadvertor's own words in their entirety followed by his own replies *seriatim*. Nowhere is his strong sense sharpened into bright and stinging wit more conspicuous than here. Moreover, broad, open-minded candour and large toleration to all honest opinion and fair argument, wedded to intense personal loyalty to his own church, are characteristic notes throughout, while it would be difficult to find a nobler example in our literature of magnanimous Christian charity tremulous with pathos than the concluding epistle to his antagonist. Bishop Nicolson, in *The English Historical Library* (2d ed. 1714), failing with one-eyed vision to see that he had before him an English classic, and one *sui generis* moreover, laments the lack of 'the gravity of an historian,' and the weakness for 'a pretty story' and for 'pun and quibble,' yet in his superior manner admits that, 'if it were possible to refine it well, the work would be of good use, since there are in it some things of moment hardly to be had elsewhere, which may often illustrate dark passages in more serious writers.'

Fuller had been presented by Lord Berkeley in 1658 to the rectory of Cranford in Middlesex, and at the Restoration he was reinstated in his former preferments. In that year he published his *Mixt Contemplations in Better Times*, was admitted D.D. at Cambridge by royal mandate, and appointed chaplain-in-extraordinary to the king. Apparently also he would have been made a bishop had he lived. He died in London after a few days' illness of the 'new disease'—a kind of typhus fever, 16th August 1661, and was buried in the chancel of Cranford church. The Latin epitaph inscribed on a mural tablet there is not so brief as his own suggestion—'Here lies Fuller's earth,' but contains a conceit worthy of his own pen, how that while he was labouring to give others immortality he obtained it himself. His great work, *The Worthies of England*, left unfinished, was edited by the pious care of his son, and published in 1662. Fuller tells us elsewhere of his 'delight in writing of histories,' and we know that the preparation of his greatest work covered nearly twenty years of his troubled life. At the outset he sets forth his five ends in the book—each one sufficient in itself: 'to gain some glory to God, to preserve the memories of the dead, to present examples to the living, to entertain the reader with delight, and to procure some honest profit to myself.' The first four were most to Fuller, and all these he gained. The *Worthies* is a magnificent miscellany of facts about the counties of England and their illustrious natives, lightened up by unrivalled originality, spontaneity, and felicity of illustration, and aglow with the pure fervour of patriotism—the very apotheosis of the gazetteer.

The earliest and anonymous biographer of Fuller tells us that his stature was somewhat tall, 'with a proportionable bigness to become it,' his countenance cheerful and ruddy, his hair light and curly, his carriage such as could have been called 'majestical' but for his complete lack of pride, his deportment 'much according to the old English guise.' Such also is the Berkeley portrait, reproduced in Bailey's *Life*. His genial disposition, the charm of his company, and his marvellous feats of memory are mentioned by Pepys and all who have since written of him.

Of the judgments passed upon his genius, best known and hardly exaggerated is that of Coleridge: 'Wit was the stuff and substance of Fuller's intellect. It was the element, the earthen base, the material which he worked in; and this very circumstance has defrauded him of his due praise for the practical wisdom of the thoughts, for the beauty and variety of the truths, into which he shaped the stuff. Fuller was incomparably the most sensible, the least prejudiced, great man of an age that boasted a galaxy of great men.' His wit is fast wedded with wisdom and strong sense, and with all its freedom is never unkindly or irreverent—he 'never wit-wantoned it with the majesty of God.' He lays a spell of quite a peculiar kind upon his reader, who will either return to him often or neglect him altogether. His style shows admirable narrative faculty, with often a nervous brevity and point almost new to English, and a homely directness ever shrewd and never vulgar; while 'his wit,' says Charles Lamb, 'is not always a *lumen siccum*, a dry faculty of surprising; on the contrary, his conceits are oftentimes deeply steeped in human feeling and passion.' The pen that described negroes as 'the images of God cut in ebony' was that of a good man as well as a great writer.

See the fine 17th-century anonymous eulogy reprinted in vol. i. of J. S. Brewer's edition of the *Church History* (Clarendon Press, 6 vols. 1845); Rev. Arthur T. Russell's *Memorials of Dr Fuller's Life and Works* (1844); Henry Rogers' *Selections and Essay* (1856); J. E. Bailey's *Life of Thomas Fuller* (1874), also his article in vol. ix. (1879) of the *Encyclopædia Britannica;* and the Rev. Morris Fuller—a descendant's *Life, Times, and Writings of Thomas Fuller* (2d ed. 1886). Bailey's unique collection of books relating to Fuller was acquired by the Manchester Free Library in 1889.

Fuller's Earth, a mineral consisting chiefly of silica, alumina, and water, with a little magnesia, lime, and peroxide of iron. The silica is about 53, the alumina 10, and the water 24 per cent. of the whole. It is regarded as essentially a hydrous bisilicate of alumina. It occurs in beds, associated with chalk, oolite, &c.; is usually of a greenish-brown or a slate-blue colour, sometimes white; has an uneven earthy fracture and a dull appearance; its specific gravity is from 1·8 to 2·2; it is soft enough to yield readily to the nail; is very greasy to the touch; scarcely adheres to the tongue; falls to pieces in water with a hissing or puffing sound, but does not become plastic. It has a remarkable power of absorbing oil or grease; and was formerly very much used for fulling cloth (see WOOLLEN MANUFACTURE), for which purpose it was considered so valuable that the exportation

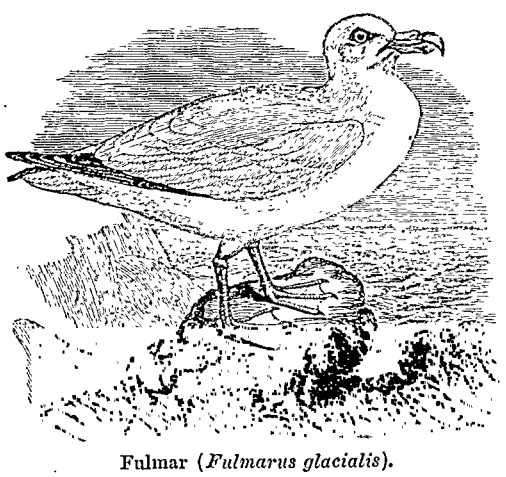
of it from England was prohibited under severe penalties; it is still used to a considerable extent. The annual consumption in England is said to have at one time exceeded 6000 tons. It is found at Nutfield, near Reigate, in Surrey, in cretaceous strata, where it forms a bed varying in thickness from less than 8 feet up to 12 feet or more. The lower part of this bed is blue, but, owing to the peroxidation of iron, the upper portion is buff-coloured—the change being brought about by the infiltration of water. It is also found in Bedfordshire, Nottinghamshire, Kent, Surrey, and elsewhere. There is a considerable deposit of it at Bath, where the group of associated blue and yellow clays and marl has received the name of 'the Fuller's Earth Series,' belonging to the Jurassic system. It is also found at Maxton in Scotland, and at various places on the Continent, as in Saxony, Bohemia, and near Aix-la-Chapelle.

Fuller's Herb or **Teasel.** See TEASEL.

Fullerton, LADY GEORGIANA, writer of religious novels, daughter of the first Earl Granville, was born at Tixall Hall, Staffordshire, 23d September 1812, and in 1833 married Alexander Fullerton. Two years after publishing her first story, *Ellen Middleton* (1844) she became, under the influence of the Tractarian movement, a convert to Catholicism. The rest of her life was devoted to charitable works and the composition of religious stories: *Grantley Manor* (1847), *Constance Sherwood* (1864), *A Stormy Life* (1864), *Mrs Gerald's Niece* (1871), *Gold-digger and other Verses* (1872). She died at Bournemouth, 19th January 1885. See her Life by Father Coleridge, from the French of Mrs Craven (1888).

Fulmar, or FULMAR PETREL (*Fulmarus*), a genus of sea-birds, in the family Procellariidæ, beside the albatross, the storm petrel, and the puffin, and near the gulls (Laridæ). The genus includes some forty species, which are widely distributed and strictly oceanic. The members agree in general features with the petrels proper (Procellaria), and all possess strong hooked bills. The general appearance is gull-like; the wings long and the flight powerful; the tail short; the hind-toe reduced to a sharp clawed wart. They are said to defend themselves from attack by disgorging an ill-flavoured oily secretion from the alimentary canal.

The best-known species, the common Fulmar (*F. glacialis*), frequents the northern seas in numbers so immense that Darwin awards it the somewhat unverifiable credit of being the most abundant of birds. It is a rarity on British or indeed European coasts, but nests or at least used to nest in St Kilda, Skye, Barra, and Foula, and is common farther north in the Faroes, Iceland, Spitzbergen, and similar localities. The bird is about the size of a duck, has the general colouring of the common gull (*Larus canus*), and is well known as the Greedy Molly-mawk, which, with beautiful gliding flight, follows whalers and other vessels after they get north of Shetland. It feeds on fishes, molluscs, jelly-fish, on the offal of the Newfoundland cod-fisheries, on the debris thrown from the successful whalers, and is in fact an indiscriminately carnivorous bird, with a preference for blubber. On a dead whale they are said to glut themselves till they are unable to fly, and sailors not unfrequently catch them with lines and hooks baited with fat. From living whales they are said to pick the Cirripedes parasitically imbedded in the skin. They breed on rocky shores, but there is no nest worth mentioning. Although the individuals are so numerous, there is only a single egg, which has a white colour.



Fulmar (*Fulmarus glacialis*).

The greedy fulmar is of no little use to the natives of the regions where it abounds. Both eggs and young are collected and eaten, and the birds are also valued for their down and oil. In St Kilda the quest for fulmars used to be an important and extremely perilous means of livelihood, while it is said that in a single little island, Westmanæyjar, south of Iceland, over 20,000 of the strong-smelling, uninviting, young fulmars are salted every summer for winter fare. The oil, which is obtained from the flesh and stomach, is amber-coloured, and has a peculiar, persistent, and unpleasant smell. From the Pacific, *F. pacificus* is usually distinguished; and the large *F. giganteus* from southern regions is also worthy of note. See PETREL.

Fulminates. This term is applied to a class of salts having the same percentage composition as the cyanates (see CYANOGEN), but, unlike them, exploding violently when heated or struck. Like Gun-cotton (q.v.) and Dynamite (q.v.) these salts contain the group of atoms represented by the formula NO_2, and which seems to confer explosive properties in so many cases. There are many fulminates corresponding to the different metals, but it will suffice if attention is drawn to fulminating mercury and silver. *Fulminating mercury* is prepared by heating mercury with alcohol and nitric acid, and after purification it is obtained in white silky crystals, which have a sweetish taste and are soluble in water. When moist these crystals may be handled without risk of explosion, but when dry they detonate violently on being struck or when a spark falls on them. This salt is largely used in the manufacture of percussion caps, for which purpose it is mixed with nitre, sulphur, &c. *Fulminating silver* is prepared by heating a solution of nitrate of silver with nitric acid and alcohol. It forms small white needles having a bitter taste and poisonous properties. It explodes more readily than the mercury salt, and the greatest care is requisite in its manufacture. It is used in making crackers and other detonating toys.

The fulminates should never be prepared by amateurs, as accidents very readily occur.

Fulnek, a town of Moravia, 10 miles NNW. of Neutitschein, with a Capuchin convent, and manufactures of silk, cloth, and fezes. Pop. 3692. Fulnek was formerly a principal seat of the Moravian Brethren, and gave its name to *Fulneck* in Yorkshire, 5½ miles E. of Bradford, where a Moravian settlement was established in 1748.

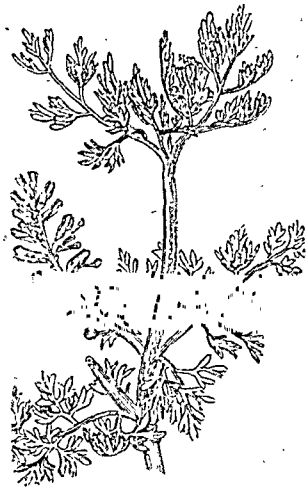
Fulton, ROBERT, a celebrated American engineer, was born of Irish parents in 1765 in what is now Fulton township, Pennsylvania. The years

1782-85 were spent in Philadelphia, where he devoted himself to the painting of miniature portraits and landscapes. In 1786 he proceeded to London, where for several years he studied under West; but some paintings which he produced in Devonshire having gained him the patronage of the Duke of Bridgewater and Earl Stanhope, he abandoned art and applied his energies wholly to mechanics, for which he had early shown a strong bent. In 1794 he obtained from the British government a patent for a double-inclined plane, the object of which was to set aside the use of locks; and in the same year he invented a mill for sawing and polishing marble. He afterwards prepared plans for the construction of cast-iron aqueducts and bridges, and patented in England a machine for spinning flax, a dredging-machine, and several boats. He was received as a civil engineer in 1795, and published a treatise advocating small canals. In 1797 he proceeded to Paris, where he remained for several years, devoting himself to new projects and inventions, amongst which was a submarine boat, intended to be used in torpedo warfare, but neither the French nor the British government, which he next tried, could be induced to take his invention up, although commissions were appointed in both cases to test its value. Having failed in this matter, he next turned his attention to a subject that had occupied his mind as early as 1793—the application of steam to navigation. In 1803 he launched on the Seine a small steamboat, which immediately sank; but a trial-trip was made by a second boat soon after, though without attaining any great speed. In 1806 he returned to New York and pursued his experiments there. He perfected his Torpedo (q.v.) system, though it was never actually adopted; and in 1807 he launched a steam-vessel upon the Hudson, which made a successful start on the 11th August, and accomplished the voyage up the river (of nearly 150 miles) to Albany in thirty-two hours. From this period steamers (for the construction of which Fulton received a patent from the legislature) came into pretty general use upon the rivers of the United States. Although Fulton was by no means the first to apply steam to navigation, yet he was the first to apply it with any degree of practical success (see STEAM-NAVIGATION). His reputation was now firmly established, and he was employed by the United States government in the execution of various projects with reference to canals and other works. In 1814 he obtained the assent of the legislature to construct a steam war-ship, which was launched in the following year, but never tested in warfare. Though the labours of Fulton were attended with such great success, various lawsuits in which he was engaged in reference to the use of some of his patents kept him in constant anxiety and tended to shorten his days. He died at New York, 24th February 1815. See his Life by Colden (New York, 1817); *Robert Fulton and Steam Navigation*, by Thos. W. Knox (1886).

Fum, or, more properly, FUNG, the Chinese Phœnix, one of the four symbolical animals supposed to preside over the destinies of the Chinese empire. Its appearance indicates an age of universal virtue, the influence of which has extended throughout creation. It is supposed to have the forepart of a goose, hind-quarters of a stag, neck of a snake, fish's tail, fowl's forehead, down of a duck, dragon's marks, the back of a tortoise, face of a swallow, and beak of a cock, with claws and feathers of various colours, red crest, and golden beak. It is about six cubits high, and comes from the East.

Fumage. See HEARTH-MONEY.

Fumariaceæ, an order of dicotyledonous herbs, allied to Papaveraceæ, of which they may be regarded as specialised forms. There are about a hundred species, mostly palæarctic, and mostly weeds, but some of great beauty (see DICENTRA). Several species of Fumaria and Corydalis are natives of Britain. The Common Fumitory (*Fumaria officinalis*) is a very common annual weed in gardens and cornfields, rank, yet of rather delicate and beautiful appearance, and easily extirpated. It was formerly much employed in medicine, as also in dyeing, and as a source of potash.



Common Fumitory (*Fumaria officinalis*).

Fumaric Acid, $H_2C_4H_2O_4$, occurs in many plants, especially in Corydalis and Fumitory. It is of interest from a chemical point of view as being isomeric with malic acid.

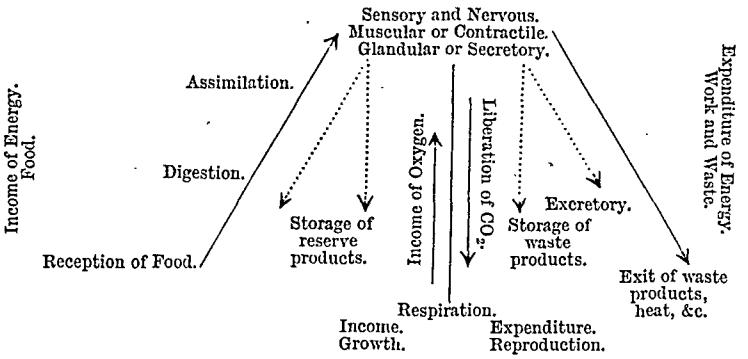
Fumigation (Lat. *fumigatio*, from *fumus*, 'smoke'), the cleansing or medicating of the air of an apartment by means of vapours, employed chiefly for the purpose of detaching infectious poisons from clothing, furniture, &c. Most of the methods of fumigation formerly employed have little real value, and are to be looked on chiefly as grateful to the senses, as, for instance, the burning of frankincense, camphor, &c. The really active processes are noticed under the article DISINFECTANTS. See also DEODORISERS, CONTAGION, INFECTION, GERM THEORY, PASTILLES.

Funaria, a genus of Mosses, of which one species common on old walls and dry barren soils, *F. hygrometrica*, is of particular interest on account of the hygrometric twisting of its fruit-stalk.

Funchal, the capital of the island of Madeira (q.v.), situated on the south side of the island, is, in spite of its exposed harbour and unsatisfactory roadstead, the chief port and commercial town of the island. Pop. 20,606. It attracts a few hundred visitors every year by the salubriousness of its climate, and has a consumptive hospital, a cathedral, Anglican and Presbyterian churches, and an English club.

Function, the technical term in physiology for the vital activity of organ, tissue, or cell. Thus it is the dominant function of the pancreas to secrete digestive juice, of a muscle to contract, of a sensory cell to receive and pass on external stimulus. The classification of the various functions or vital processes presents considerable difficulty, though it is easy enough roughly to catalogue the most important: (1) contractility (by muscular cells, tissues, and organs); (2) irritability to sensory stimulus, transmission of nervous stimulus, 'automatic' origin of nervous impulse (by sensory organs, nerves, brain, &c.); (3) secretion and excretion (by glandular cells, or complexes of these); (4) respiration (by skin, gills, lungs, &c., or necessarily in every actively living cell); (5) nutrition, digestion, assimilation (in the manifold ways in which the income of energy in the form of food is received and worked up into living matter). Somewhat apart from these, and of more

periodic occurrence, are the great processes of growth and reproduction. Or the various vital phenomena may be thus arranged in diagrammatic fashion:



In a single-celled organism, such as an Amœba, all the vital processes take place within narrow limits, and just because of the simplicity of structure there must be great complexity of function compared with what occurs in a single cell of one of the higher organisms. For here division of labour is possible, and in the different cells special functions predominate over the others. Thus, a muscle-cell is contractile but not strictly nervous, and a glandular cell is secretory without being definitely contractile. With the division of labour and resultant complexity of structure in a higher organism, various functions appear which are only foreshadowed in a protozoon. Such, for instance, is the circulatory function, establishing nutritive and respiratory communication between the distant parts. But such a multiple process can readily be seen to be the sum of several more fundamental functions. It must also be noted that, while a cell, tissue, or organ may have one dominant function, it may at the same time retain several subfunctions.

Another fact of general importance is the change of function which may be exhibited by the same organ in the course of its history—that is to say, through an ascending series of animals, or even in the development of an individual. Thus, what is a mere bladder, of little apparent account, near the hind end of a frog's gut, becomes the respiratory and sometimes nutritive Allantois (q.v.) of reptile and bird, and an important part of the Placenta (q.v.) in placental mammals. The importance of this in relation to the general theory of evolution has been emphasised by Dohrn in what he terms the principle of functional change.

Fundamentally, the functions of organs, the properties of tissues, the activities of cells, are reducible to chemical changes in the living matter or protoplasm. To the constant change in the protoplasm the general term 'metabolism' is applied, while this is again subdivided into processes of upbuilding, construction, chemical synthesis, or 'anabolism,' and reverse processes of down-breaking, chemical disruption, or 'katabolism.' See AMŒBA, BIOLOGY, CELL, PHYSIOLOGY, PROTOPLASM, and the various functions, DIGESTION, &c.—In speaking of disease, 'functional' is opposed to 'organic.'

Function. When two quantities are so related that a change in the one produces a corresponding change in the other, the latter is termed a *function* of the former. For example, the area of a triangle is a function of the base, since the area decreases or increases with the decrease or increase of the base, the altitude remaining unchanged. Again, if $u = ax^2 + bx + c$, where a, b, and c are constant quantities, and u and x variables; then u is said to be a function of x, since, by assigning to x a series of different values, a corresponding series of values of u is obtained, showing its *dependence* on the value given to x. Moreover, for this reason, x is termed the *independent*, u the *dependent* variable. There may be more than one independent variable—e.g. the area of a triangle depends on its altitude and its base, and is thus a function of two variables. Functionality, in algebra, is denoted by the letters F, f, ϕ, Φ, &c. Thus, that u is a function of x may be denoted by the equation $u = F(x)$; or, if the value of u depends on more than one variable, say upon x, y, and z, then by $u = F(x, y, z)$.

Functions are primarily classified as *algebraical* or *transcendental*. The former include only those functions which may be expressed in a finite number of terms, involving only the elementary algebraical operations of addition, subtraction, multiplication, division, and root extraction. Several terms are employed to denote the particular nature of such functions. A *rational* function is one in which there are no fractional powers of the variable or variables; *integral* functions do not include the operation of division in any of their terms; a *homogeneous* function is one in which the terms are all of the same degree—i.e. the sum of the indices of the variables in each term is the same for every term. For example,

$$x^4 + x^3y + x^2y^2 + xy^3 + y^4$$

is a rational, integral, homogeneous function of the fourth degree in x and y. *Transcendental* functions are those which cannot be expressed in a finite number of terms; the principal types are (1) the exponential function e^x, and its inverse, $\log x$; (2) the circular functions, such as $\sin x$, $\cos x$, $\tan x$, &c., and their respective inverses, $\sin^{-1}x$, $\cos^{-1}x$, $\tan^{-1}x$, &c.

Functions are also distinguished as *continuous* or *discontinuous*. Any function is said to be continuous when an infinitely small change in the value of the independent variable produces only an infinitely small change in the dependent variable; and to be discontinuous when an infinitely small change in the independent variable makes a change in the dependent variable either finite or infinitely great. All purely algebraic expressions are continuous functions; as are also such transcendental functions as e^x, $\log x$, $\sin x$, $\cos x$.

Harmonic or *periodic* functions are those whose values fluctuate regularly between certain assigned limits, passing through all their possible values, while the independent variable changes by a certain amount known as the period. Such functions are of great importance in the theory of sound, as well as in many other branches of mathematical physics. Their essential feature is that, if $f(x)$ be a periodic function whose period is a, then $f(x + \frac{1}{2}a) = f(x - \frac{1}{2}a)$, for all values of x.

The term *derived function* is used to denote the successive coefficients of the powers of h in the expansion of $f(x + h)$, where h is an increment of x. If x becomes $x + h$, then $f(x)$ changes to $f(x + h)$, and it may be shown that $f(x + h) = f(x) + f'(x)h + f''(x)h^2 + f'''(x)h^3 +$ &c.; $f'(x)$, $f''(x)$, $f'''(x)$, &c. are the first, second, third, &c. *derived functions* of $f(x)$. It is the primary object of the differential calculus to find the value of these for different kinds of functions.

Fund, SINKING. See SINKING FUND.

Fundi, or FUNDUNGI (*Paspalum exile*), a kind of grain allied to the millets, much cultivated in the west of Africa. See MILLET, PASPALUM.

Funds. See NATIONAL DEBT.

Fundy, BAY OF, an arm of the Atlantic, separating Nova Scotia from New Brunswick, and branching at its head into two inlets, Chignecto Bay and Minas Basin, which are separated by narrow necks of land from the Gulf of St Lawrence. It has an extreme breadth of 45 miles and a length up to Chignecto Bay of 140 miles; it receives the St John, the principal river of New Brunswick, and the St Croix, which separates that province from Maine. The navigation is rendered perilous by the tides, which rush in with impetuous force, rising rapidly from 60 to 70 feet.

Fünen, or FÜHNEN (Dan. *Fyen*), the largest of the Danish islands after Zealand, is separated from Sleswick and Jutland on the W. by the Little Belt, and from Zealand on the E. by the Great Belt. With the islands of Langeland, Ärö, Taasinge, &c., it forms the two administrative districts of Odense and Svendborg. Area of Fünen, 1135 sq. m.; pop. (1880) 206,528. The coast is for the most part flat and sandy; on the north it is indented by the deep Odense Fjord. The interior is flat, except towards the south and west, where there is a range of hills rising to about 420 feet. The land, which is well watered by several small streams, is fruitful and well cultivated, producing abundant crops of cereals. Barley, oats, buckwheat, rye, flax, hemp, honey, horses, and a fine breed of horned cattle are exported. The island is crossed by several railway lines. The principal towns are Odense (25,600 in 1885), Svendborg (7184), and Nyborg (5402).

Funeral Rites, the customs attending the burial or other disposal of the bodies of the dead, the various practical methods of which are discussed under the article BURIAL. These ceremonies of course vary with the method preferred, whether of burial in the earth, exposure upon the tops of trees and towers as practised by the Parsees, or of burning in the usage of the ancient Greeks and later also the Romans. The effect of Christianity was to add a new sanctity to the body from the belief in its resurrection in a glorified form, hence the burial in places specially set apart for that purpose with more or less elaborate religious ceremonies, the washing, anointing, stretching, and swathing of the body in white robes (once in England only in woollens), the strewing of the coffin with palms and rosemary rather than cypress, and its position in the grave with face upward and feet to the east, towards the second coming of the Lord. Nowadays in Britain and America there are few distinctive customs beyond the religious rites, the wearing of black as a mourning colour, and the accompanying the body to the grave, expressive of respect; but formerly many customs were in use, as the ringing of the *passing* bell to drive off demons who might be in waiting for the newly-released soul; the constant watching with the dead betwixt death and burial—the *lykewake*—once universal, and still surviving, with degrading circumstances and without meaning, in the Irish wake; setting a plate of salt upon the breast of the body and lighted candles at its head; and the serving of profuse repasts of meat and drink to all and sundry, as well as special doles of food and clothing to the poor. Aubrey in his *Remaines of Gentilisme and Judaisme* tells us of a singular custom as having been formerly practised in Herefordshire, of a man eating a loaf of bread and drinking a bowl of beer over a dead body, and thereby symbolically taking upon himself the sins of the deceased. The analogy is obvious between the sin-eater and the scapegoat of the ancient Jewish Day of Atonement.

Funeral rites symbolise affection and respect for the deceased and grief for his loss, or they may be attempts to deprecate the ill-will of a now powerful ghost. The belief in the continuance of life beyond the grave is a universal human possession, and most savages attach ghost-souls also to animals and even inanimate objects, which may accompany the souls of men into the spirit-world as in life. Hence the meaning of the North American Indians burying bow and arrow with the dead, the old Norse warrior having his horse and armour laid beside him in his barrow, the Hindu widow's inveterate desire to be burnt herself to death together with her husband's body, the head-hunting of the Dyaks in order that a man may not be unprovided with slaves after his death, the burying of money together with the corpse and even the *obolus* for Charon's fee among the ancient Greeks, as well as such a survival as our own leading the trooper's horse behind his master's bier instead of burying him in his grave.

The funeral rites of the ancient Egyptians were most elaborate, but it is scarcely safe to claim their preference for embalming as conclusive proof of their belief in a resurrection of the body, as they embalmed animals as well as men, and did not preserve some of the most important internal parts of the human bodies they embalmed.

See the articles ANCESTOR-WORSHIP, BURIAL, EGYPT, and EMBALMING; for the religious significance of funeral rites in Herbert Spencer's theory of religion, his *Principles of Sociology*, but for a safer guide to interpretation, Tylor's *Primitive Culture* (vol. ii.); also for the facts, Feydeau, *Hist. générale des Usages funèbres et des sepultures des Peuples anciens* (3 vols. Paris, 1858); De Gubernatis, *Storia popolare degli usi funebri Indo-Europei* (1873); Tegg, *The Last Act* (1876); and Sonntag, *Die Todtenbestattung* (1878).

FUNERAL EXPENSES, in Law. If limited to the degree and quality of the deceased and the estate he has left, funeral expenses are a privileged debt, allowed before all other debts and charges, both in England and Scotland. If the parties primarily liable neglect the duty of giving decent burial to the dead, a stranger may do so, and claim reimbursement out of his effects. In Scotland it is held that moderate and suitable mourning for the widow and such of the children of the deceased as were present at the funeral is a valid charge; but the reverse is the case in England, it having been decided that the widow has no claim for mourning either against the executor or the creditors of her husband.

Fünfhaus, a suburb of Vienna lying SW. of the city. Pop. (1880) 39,967, principally engaged in weaving, wood-turning, and building.

Fünfkirchen ('Five Churches,' from five mosques built during the Turkish occupation, in the 16th century; Hungarian, *Pecs*), a free town of Hungary, capital of the county of Baranya, on the vine-clad southern slope of the Mecsek Mountains, 139 miles S. by W. of Pesth by rail. Its bishopric was founded in 1009, and it is one of the oldest, as well as one of the most pleasantly situated and beautiful towns of Hungary. It formerly possessed

a university. The most important of its buildings are the Romanesque cathedral (1136), the bishop's palace, the town-house and hospital, and the county buildings. Its manufactures include leather, woollens and flannels, oil, brandy and liqueurs, and a famed majolica ware; it produces wine, fruit, and tobacco, and has coal-mines and marble-quarries, and a flourishing trade in hogs and gall-nuts. Pop. (1881) 28,801.

Fungi. The early botanists 'considered the fungi to be *lusus naturæ* and no plants at all,' and regarded their strange and fitful appearance without flower or apparent seed as the strongest argument for spontaneous generation. The bland wholesomeness of some, yet frightful poisonousness or destructiveness of many others, with their consequent world-old association with that crude and fanciful pharmacy in which ancient medicine and witchcraft were so inseparably intermingled, not a little enhanced these mysteries. Hence, although in Sterbeeck's *Theatrum Fungorum* (1675), the first published book entirely devoted to cryptogamic plants, there is an excellent account and many figures of fungi, it was not, and indeed could not be, until after that primary task of natural science initiated by Linnæus—the compilation of the 'System of Nature,' the orderly descriptive catalogue of natural things—had made considerable progress in almost all other directions, that its chapter dealing with the fungi was fully commenced. From about 1780 onwards we have illustrated cryptogamic floras essentially of the modern type, which not only soon reached tolerable completeness for the more obvious forms, but with the introduction and improvement of the microscope even made rapid progress with that description of the multifarious minor forms which is even now far from ended. It thus became known that some were produced from reproductive cells or spores, just like a plant from its seed; hence for this Linnean school, whose central monument is the works of Fries, each new form was, naturally enough, simply a new species to be described. The identification, however, of the fern and its prothallus (see FERNS) as phases of a single life-history, and the thorough reinterpretation of the higher cryptogams and their unification with the flowering plants thereupon effected by Hofmeister, naturally gave a fresh impetus to the study of the remaining lower groups of algæ and fungi. For fungi, this new movement was headed by Tulasne, who from 1851 onwards showed that many of the different form-species hitherto described were actually nothing more than the phases of a single protean life-history. Tulasne essentially relied upon the actual anatomical continuity of different adult forms, upon finding reproductive structures hitherto regarded as specifically distinct on one and the same vegetative body or mycelium; while De Bary confirmed and extended these results by the complementary method of cultivation from the spore. Tulasne's new doctrine of 'the pleomorphism of the fungi' aroused storms of controversy; but the bigoted conservatism of the systematists in the defence of their results, and the exaggerated speculation and practical blundering of the younger school in the reinterpretation of them, gradually subsided as the just claims of each obtained mutual recognition; and thanks to many workers, but especially to the exact labours of De Bary and his many pupils, the classification and morphology of fungi have thereafter been in harmonious progress.

It was long before any satisfactory definition of fungi was possible, their association with algæ (themselves scarcely better known) at first resting merely upon the negative characters which excluded both from the higher plants. Their physiological peculiarities, however, were more apparent; and their definition as a 'natural order' (or, as it gradually appeared, a vast class) was accepted as 'embracing all Thallophytes which do not vegetate by means of intrinsic chlorophyll.' The progress of research demonstrated the remote distinctness of some types of these from others, and the intimate relationship of certain fungi to particular algæ of which they seemed to be merely the colourless forms. Hence it was argued, especially by the physiologist Sachs, that such forms were no more entitled to separate classification apart from the algæ than were the very various types of flowering plants—e.g. dodder and broom-rape—which merely agree in having lost their chlorophyll through parasitism, apart from the ordinary green plants to which they are respectively akin. Abandoning, then, the physiology of the vegetative system, he proposed a classification of the algæ and fungi according to their degree of reproductive development (see ALGÆ). This was, however, going too far, and systematists have returned to the more conservative proposals of De Bary, who excludes entirely from the fungi the Bacteria (q.v.) and the Myxomycetes, and, while recognising that certain fungi are doubtless merely the colourless representatives of particular algal groups, yet vastly simplifies the subject by insisting upon 'an Ascomycetous series or main series of fungi,' albeit with more or less doubtfully related outlying forms.

At the outset of this great series are usually described two orders (sometimes united as Oomycetes), both closely related in vegetative and reproductive type to such simple algæ as Vaucheria (see ALGÆ). These are the Peronosporeæ, including such well-known moulds of living plants as *Phytophthora infestans* (Potato Disease, q.v.), *Cystopus candidus* (White Rust of cruciferous plants), also Pythium and Peronospora. The allied Saprolegnia (see SALMON) gives its name to the other family.

Of the Zygomycetes the commonest type is *Mucor mucedo*, the common white mould of dead

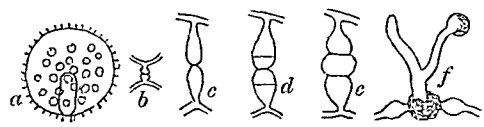


Fig. 1.—White Mould (*Mucor mucedo*):
a, ripe sporangium with few spores represented to show internal septum ingrown as columella; *b*, beginning of conjugation between two adjacent hyphæ; *c*, *d*, *e*, later stages of the process; *f*, germination of the thick-walled resting spore, with short vegetative and immediate reproductive hypha.

organic matter, particularly horse-dung, a form easily cultivated and in every way peculiarly suitable for beginning the study of fungology. Starting with a spore, this germinates into a filament or *hypha*, which remains unicellular like that of the preceding forms, and grows and branches rapidly through the nutrient material or solution, the whole growth of hyphæ being termed the *mycelium*. Soon erect hyphæ begin to bud from the older hyphæ of the mycelium; the tips of these enlarge into spherical heads, which become separated off as distinct cells, the future sporangium, by a partition which grows, however, inwards, into the interior of the enlarging spherical head, as the *columella*. The protoplasm of the sporangium is meantime dividing into a multitude of tiny cells, which surround themselves with cell-walls as spores, while the mineral waste products of this active change are deposited in the common sporangial wall, rendering it exceedingly brittle. This readily breaks, scattering the spores, which immediately recommence the same development.

Sooner or later, however, a more evolved process

of reproduction is needed, and two adjacent hyphæ conjugate much as in Spirogyra (see fig. 1, *b*—*c*, and ALGÆ, fig. 4). The resultant zygospore after a period of rest germinates with only a rudimentary mycelium, and immediately reproduces the characteristic asexual sporangium. Empusa, of which *E. muscæ* is largely fatal to house-flies in autumn, is the type of the analogous order Entomophthoreæ. The Chytridiaceæ are an order of minute fungi of which the life-history is fundamentally similar to that of the Protococcaceæ among algæ.

The Ustilagineæ are a large family, parasitic on phanerogamous plants. Their mycelium ramifies through the intercellular spaces of the host, and forms also densely-woven masses of spore-bearing hyphæ, which show various degrees of differentiation as *compound sporophores*, so foreshadowing those of higher fungi. These spores produce a short mycelium, of which the branches conjugate in pairs, while the new mycelia thereafter arising re-enter the plant and in time produce new asexual spores. Some are formidable pests of agriculture (Ustilago, Tilletia).

ASCOMYCETES proper.—The mycelium is always composed of multicellular hyphæ, which in the higher forms interweave into the stroma or thallus, which assumes various characteristic forms and bears the short reproductive hyphæ, which in turn bear the spore-mother cells or *asci*. These are usually tubular, and on reaching full size their protoplasm collects at the top, and the nucleus

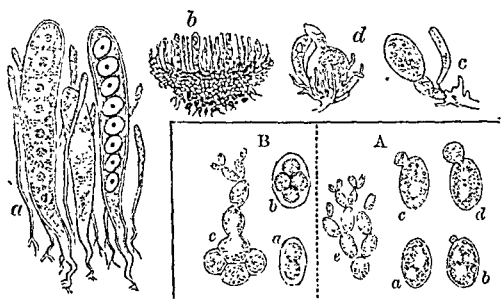


Fig. 2.—Peziza. *a*, asci, with barren filaments (paraphyses); *b*, section of fructification surface (*hymenium*); *c*, preparations for the

Fig. 2*a*.—Yeast (*Saccharomyces cerevisiæ*): *A*, *a*, *b*, *c*, *d*, early stages of budding; *e*, later stages; *B*, starved yeast cell, dividing at *a* to

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divides repeatedly, usually producing eight nuclei, which collect protoplasm around them, and, developing cell-walls, become perfect *ascospores*. In all save a few of the lowest forms (Eremascus, Exoascus, &c., which are accordingly grouped as Gymnoasci) the fructification is in distinctly developed *sporocarps*. In these, besides the ascogenous hyphæ with their asci, there is an *envelope* derived from distinct hyphæ of the stroma, which also send in amongst the asci a multitude of barren filaments, the *paraphyses*. The aggregate of asci and paraphyses is termed the hymenium (see fig. 2, *a*, *b*). Tulasne and De Bary have shown with tolerable certainty (despite the doubts of Van Tieghem and Brefeld) that the whole fructification arises in consequence of a conjugation of similar hyphæ in the lowest forms (Eremascus), or the sexual union of dissimilar ones in higher forms (e.g. Peziza, fig. 2, *c*, *d*).

A brief systematic enumeration of the orders and leading illustrative forms of Ascomycetes will be found of service:

(1) *Gymnoasci*.—Asci not forming definite sporocarps with envelope (Eremascus, Exoascus).

(2) *Discomycetes* (800 species).—Sporocarp with envelope, but hymenium completely uncovered, at least at maturity. The most important genus is Peziza, of which the shallow cup-like sporocarp is open from the beginning, though in the allied Ascobolus the envelope encloses the hymenium during development and bursts, scattering the spores. Bulgaria resembles this, but is gelatinous. In Dermatia the cup is leathery or horny. In Stictis the hymenium is almost withdrawn into the stroma, while in Phacidium the sporocarp only breaks out and opens when ripe. In a second but less important family the sporocarps are leathery and black, elliptical, linear, or winding; of these Hysteriæ the commonest is *Rhytisma accrinum*, which forms the large black spots that appear upon almost every leaf of the common maple towards autumn. The Helvellacei represent an opposite type of development; the large sporocarps are stalked, with club or hat shaped hymenia, open and uncovered by the envelope from the beginning. Many are important as esculent, notably the morels (*Morchella esculenta, deliciosa*, &c.), also *Helvella esculenta*. The mycelium of *Rœsleria hypogæa*, found on dead and diseased vine-roots, is the 'pourridié de la vigne' of wine-growers.

Among the Discomycetes the life-history is often rendered more complex by the mycelium constricting off *acrospores* from the tips of erect filaments, these acrospores readily reproducing the mycelium. This stage of *Peziza Fückeliana* was formerly known as *Botrytis cinerea*; and many other acrospore-bearing moulds still await similar identification. Vegetative hyphæ also frequently interweave into dense resting masses or *sclerotia*, as also in the species just named, and those may either redevelop acrospore-bearing hyphæ or (after a winter) give rise to true hymenial cups. Acrospores, too, may be developed either upon isolated hyphæ or in pseudo-hymenial groups, which may be open or flask-shaped (*pycnidia*). Nor are the many possibilities of 'pleomorphic' variation thus opened up by any means confined to the Discomycetes.

(3) *Pyrenomycetes*.—This is a large order of small and inconspicuous fungi, in all respects representing a further differentiation of the Discomycete type, primarily in the deepening of the shallow cup-shaped hymenium into a deep flask with minute apical opening (*perithecium*), but also in a more varied development—the most extreme among fungi—of pleomorphism or alternation of generations. The number of species is hence very uncertain. Besides the important Ergot (*Claviceps purpurea*, see ERGOT), and its curious ally Cordyceps, which attacks caterpillars, moths, wasps, &c., with its fructification, thus forming the extraordinary 'animal-plants' and 'vegetating insects' which so perplexed the early naturalists, any of the common forms into which the old (and once all-comprehensive) genus Sphæria has been broken up will serve as type, conveniently Nectria, common in red patches upon dead wood. Some form parasitic patches within lichens.

(4) *Perisporiaceæ*.—In these the perithecia are completely closed capsules which fall to pieces on ripening; there are no paraphyses. The mycelium is thread-like, and acrospores are frequent. Of the 100 species some are notable pests, witness Erysiphe and others, commonly grouped as Mildew (q.v.), *Oidium Tuckeri*, a pestilent vine disease, &c. Easily distinguished by the dark or inconspicuous mycelium are the species of Fumago. To this group also belongs Eurotium, of which the common Bread Mould (*E. Aspergillus-glaucus*) is a type commonly put before the botanical student, from the comparative facility with which the sexual

process, which sets in after prolonged multiplication by acrospores, can be observed, with its resultant

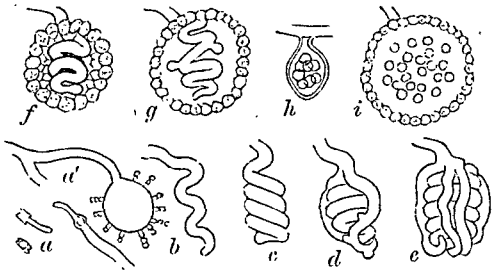


Fig. 3.—Eurotium Aspergillus-glaucus:
a, a germination of spore in three phases; *a'*, head of reproductive hyphæ-bearing spores; *b*, *c*, appearance of conjugating filaments; *d*, *e*, growth of enveloping coat, complete in *f*; *g*, first appearance of asci (two buds); *h*, a ripe ascus; *i*, spores lying loose and ready to be set free.

development of the perithecium and its asci (see fig. 3).

(5) *Tuberacei.*—In this group, as in the preceding, the hymenium is permanently without external opening, but the chambers become narrow, coiled, and branched, and the whole complex sporocarp thus attains an extreme complexity. Most are subterranean, and are best represented by the important genus Tuber (see TRUFFLE). With this (or sometimes in the last group near Elaphomyces) is to be reckoned the very common mould of jam, bread, &c. (*Penicillium glaucum*); it rarely, however, attains full development beyond the acrospore-bearing form.

(6) *Lichenes.*—As the majority of lichen-forming fungi belong to the Ascomycetes, the lichens are very commonly now described under this head by recent writers. Yet not only the time-honoured distinctness of this group, but its remarkable variety and interest make separate treatment still expedient, hence see LICHENS.

Besides the large number of forms in which the existence of an acrosporous phase as yet rests upon analogy alone, De Bary reckons as 'doubtful Ascomycetes' such forms as Laboulbenia, Exoascus, and also the important species which excite alcoholic fermentations, Saccharomyces (fig. 2*a*). See YEAST, FERMENTATION.

From forms in which the characteristic mode of reproduction of the Ascomycetes is only doubtfully represented we readily pass to those in which it does not appear at all, but in which multiplication occurs only by acrospores or basidiospores, which may be of various forms. One group, however, we have to consider in which the sporocarp, here termed an *æcidium*, so closely resembles that of an Ascomycete as to induce De Bary and most writers to reckon it with these rather than with the following series.

(7) *The Uredineæ or Æcidiomycetes.*—These are the Rust fungi, a remarkable series of parasitic moulds, formerly associated with the Ustilagineæ, which they somewhat resemble in habit, but from which they differ in structure and life-history. The alternation of generations is remarkably complete and well differentiated, the different forms having constantly been reckoned in distinct genera, which are as yet by no means fully criticised. The most familiar case is that of the Rust of wheat (*Puccinia graminis*), in which the generation found on the barberry was described as *Æcidium berberidis*. Other important forms are known as *Uredo* sp. &c.; to this group is also reckoned the coffee disease of Ceylon, *Hemileia vastatrix*. The life-history of the group will be understood by reference to RUST.

BASIDIOMYCETES.—We now come to the Basidiomycetes proper, which derive their name from the *basidia* which segment off or 'abjoint' the spores (fig. 4, *d*). These are usually non-parasitic and have generally large and well-developed sporocarps; they are divided into two main groups.

A. HYMENOMYCETES.—Hymenium exposed upon the surface of the sporocarp.

(*a*) *Tremellini.*—Gelatinous with basidia each bearing only one spore, often arising laterally—Auricularia (Jew's Ear), Tremella (q.v.).

(*b*) *Hymenomycetes proper*, not gelatinous, two to six spores arising on each basidium (fig. 4, *a*—*d*).

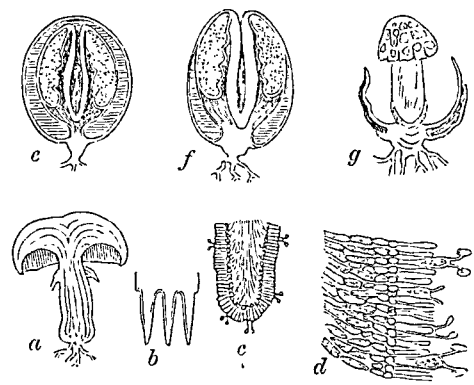


Fig. 4.
a, vertical section of an [illegible] three 'gills;' *c*, sectic [illegible] hyphæ-bearing basidia, [illegible] *b*, section of [illegible] ing course of [illegible] es; *d*, portion more highly magnified; *e*, young Phallus (*Gasteromycetes*); *f*, the same at moment of rupture of peridium; *g*, more fully opened (the same figure on a smaller scale).

In the simplest forms the sporocarp is erect or branched, and bears a hymenium over its whole surface. Of this small group of (1) Clavarinei many species of Clavaria are common.

(2) In the allied Thelephorei the hymenium forms also a simple smooth surface, but is restricted either to the upper or under surface; in the latter case the fungus may be sessile or stalked, and have a distinct 'hat' or pileus (Thelephora, Stereum, &c.).

(3) In the Hydnei the hymenium becomes differentiated in various irregular and discontinuous forms, which may be warty, bristly, or comb-like.

(4) In the Polyporei the hymenium is continuous, but with many more or less tubular depressions. Here belong several important genera, notably Boletus (q.v.), Polyporus (see AMADOU), Fistulina (q.v.), as well as the pestilent *Merulius lachrymans* (Dry Rot, q.v.).

(5) In the immense group of Agaricini (1200 European species) the series culminates, the hymenium being arranged in regular radiating lamellæ or gills. Most important of course is the genus Agaricus and Mushroom (q.v.), which is broken up into many subgenera (Amanita, Armillaria, &c.). Cortinarius, Hygrophorus, Russula, Lactarius, Coprinus, Cantharellus (chantrelle), Marasmius are also important. Many of these are edible, others again poisonous.

B. GASTEROMYCETES.—Here the spores arise quite as in Basidiomycetes; but the hymenia are completely enclosed within the fungus-body. Of this the outer layer (*peridium*) becomes differentiated from the deeper substance (*gleba*). Both layers may undergo very remarkable histological and anatomical modifications, and these changes of ripening often result in the sudden acquirement of the most extraordinary forms. Hence, although the species are by no means so numerous (about 550), there are 70 genera. These are mostly large fungi,

often edible, at least in the young state; few are positively poisonous.

(1) Of the mostly subterranean and truffle-like Hymenogastrei, one genus, Gautiera, affords an interesting transition from the Hymenomycetes, its hymenial depressions remaining open and uncovered by any differentiated peridium. In the remaining types (Hymenogaster, &c.) the gleba contains many closed internal hymenial chambers, but remains continuous with the simple peridial coat.

(2) The Sclerodermei differ little from the preceding, save in the more differentiated peridium, from which the gleba dries away in a brittle network, lining the chambers, which become filled with spores. *Scleroderma vulgare* is sometimes used as an adulterant of truffles, but is commonly regarded as inedible.

(3) In the simplest Lycoperdinei or puff-balls the gleba may remain unchambered, but the tissue of the gleba usually breaks up into a woolly mass of dried hyphæ; hence the peridium when broken on ripening discloses a dusty mass of threads and spores (Lycoperdon, Bovista). See PUFF-BALL.

(4) In another series, the Phalloidei in the widest sense, we have a very singular series of forms. This begins with the simple earth-star (Geaster), which is essentially a puff-ball with outer and inner peridium, of which the outer opens into radiating lobes. In Batarrea, the gleba, covered with the inner peridium, becomes raised upon a long stalk; in Phallus (see fig. 4, *c, f, g*) the outer peridium, fibrous outside, becomes gelatinous within, while the stalk pushes the gleba through the inner peridium also, as a naked cap from which the spores drop away; while in Clathrus it is the inner peridium which expands as a large network.

(5) In the last series, that of Nidulariei, the external peridium opens, disclosing several separate 'peridioles,' each containing a hymenial tissue, which breaks down into a mass of spores. These are the 'bird's-nest fungi' (Cyathus, Nidularia, &c.). The origin of the Gasteromycete sporocarp from its mycelium appears to be without any sexual process, but by a process of direct growth and differentiation of an upgrowth upon its mycelium. In Hymenomycetes a sexual process has been sometimes described, but not with absolute certainty. We know, however, how constantly the abundant nutrition of an organism leads to the relapse from sexual to asexual multiplication.

As an appendix to this outline of classification, it is necessary to note that we not unfrequently find sterile mycelium forms, to which any definite systematic position frequently cannot be given. Such are, for instance, the well-known *Racodium cellare* of wine-cellars. There has been much dispute over the nature of the complex strands of Rhizomorpha, now regarded as belonging for the most part to *Agaricus mellens*, while the old genus Sclerotium has long been recognised as a resting state of many diverse forms—e.g. Ergot.

Germination.—Most spores are capable of immediate germination: such are most acrospores (*gonidia*), almost all acrospores, and most spores of Hymenomycetes. Some, however, require a period of rest: such are most oospores, zygospores, winter spores, &c. Although some spores perish almost immediately, many others exhibit considerable powers of resistance to heat, cold, drought, &c.; those of some moulds have been germinated from herbarium specimens three to ten years old. For germination we require a reasonable temperature, varying with the species, with supply of oxygen and moisture; nutritive matter may also be necessary. Many spores, however, have never as yet been observed to germinate at all, notably those of the truffle and some other Ascomycetes, of most Gasteromycetes, and of a few Hymenomycetes, including even the common mushroom.

Nutrition and Mode of Life.—The characteristic absence of chlorophyll renders the fungus unable to decompose carbonic anhydride. Hence it must depend upon organic compounds already formed. Almost any soluble carbon compound, not too poisonous or too fully oxidised (such as formic or oxalic acid, urea, &c.), will, however, serve for this, and similarly with most nitrogen compounds, even urea. The constituents of the ash can also be obtained from a wide range of substances. Penicillium grows best in a solution of proteid (peptone) and sugar, yet can be grown, of course with diminishing vigour, upon a whole series of poorer solutions, down to ammonium acetate. All of course give off carbonic acid in respiration, and a few are remarkably phosphorescent.

Such facts help us more clearly to understand the wide range of habitat presented not only by the different members of the group, but by the same species. Those fungi which normally obtain their organic matter from the dead organic matter of decaying bodies are termed *saprophytes*, while those which obtain them from living plants or animals are termed *parasites*. The former is doubtless to be regarded as the primary state of things, and includes the great majority of fungi, yet many normal saprophytes exhibit 'facultative parasitism,' and conversely normal parasites may exhibit 'facultative saprophytism.' Many saprophytes require a specific substratum—e.g. dung, feathers, &c. —just as many parasites have only a single host; others again have a very wide range of habitat. The chemical effects of the growth of fungi, with which, for physiological purposes, we may also reckon the Bacteria (q.v.), upon organic substances are outlined under FERMENTATION and PUTREFACTION. The relation of specific parasites to their hosts, besides mention in the various special articles, such as ERGOT, MILDEW, and RUST, is more generally treated under PLANTS (DISEASES OF) and PARASITISM; the pathological bearings come under GERM THEORY and PATHOLOGY. That remarkable adjustment of fungus and host which rises beyond the pathological level into the healthy and permanent mutual adaptation known as *symbiosis* is described, for the association of fungus and alga, under LICHENS, and for that of fungus-mycelia with the roots of phanerogamous trees, the so-called Mycorhiza, under ROOT.

Uses of Fungi.—Of species used in medicine, the only one now of importance is Ergot (q.v.): the narcotic use of the Siberian fungus has also been described under AMANITA. Amadou (q.v.) and Moxa (q.v.) are old sources of tinder, and *Polyporus squamosus*, cut in slices, was much used for razor-strops. But the chief use of fungi is for food, and in the manufacture of Ketchup (q.v.).

Although few fungi are used as food, and most popularly regarded as poisonous, the positively dangerous species are really by no means very numerous. Yet the risks of incautious gathering must not be understated, since not only are some edible fungi liable to be confounded with poisonous forms, but some normally wholesome forms acquire poisonous properties under particular circumstances, although whether this be due to definite variation or to the chemical changes of incipient decomposition remains doubtful. Hence our common mushroom is excluded from the Italian markets. There is no certain rule which can supersede the need of experience and caution in discriminating wholesome from unwholesome forms, the popular beliefs—e.g. that the latter only will discolour a silver spoon if stirred with it while being cooked, or that they are more readily deliquescent—being without foundation. Nor does colour or odour afford any certain

test, for, although most forms of gaudy exterior or readily changeable internal colour may be suspected, and all fetid ones of course avoided, some poisonous ones are quite inconspicuous and inoffensive. Again, some which are pungent and acrid while raw become bland and wholesome when cooked; maceration in vinegar or brine produces a similar effect.

The importance of fungi as an article of diet is naturally minimised in Britain through the prevailing ignorance and the consequent excessive distrust; in France, and especially in Italy, they are of much greater importance. The culture of the Mushroom has, however, of late years become increasingly frequent, while on the Continent that of a number of other species has long been practised with more or less success, as notably of Agaricus, Boletus, &c., and more recently of the truffle. The leading edible fungi have already been noted, and are also in most cases the subject of separate articles; it may suffice therefore here to bring together the most important. Besides the Mushroom, its immediate congeners, and its closer allies, such as the Chantrelle (*Cantharellus cibarius*), we have among the Hymenomycetes a number of species of Boletus and of Polyporus, also *Fistulina hepatica*, and several species of Lactarius, Hydnum, and Clavaria, with *Marasmius oreades*. Among Gasteromycetes, the puff-balls (Lycoperdon, Bovista), in the young state. Of Ascomycetes, the Morel, Helvella, with Verpa, some of Peziza, &c., and, of course, above all others, the Truffle. *Cyttaria Darwinii*, which grows on beeches in Tierra del Fuego, forms an important article of native diet.

Poisonous Effects and Treatment.—Noxious species may produce sometimes irritant, sometimes narcotic effects. The effects appear soon after the meal, and may be manifested by giddiness, dimness of sight, and debility. The person may seem intoxicated, and there may be singular illusions of sense, while even spasms and convulsions may appear in the most serious cases. In most cases, however, recovery takes place, especially if vomiting be early induced. Hence emetics should be administered as promptly as possible, and castor-oil also given freely.

For general accounts of fungi, see the leading textbooks of botany, notably Goebel's *Outlines of Classification* (Oxford, 1887), and those of Van Tieghem and Luerssen; or, very conveniently, Bennett and Murray's *Cryptogamic Botany* (Lond. 1889). The central work is De Bary's *Comp. Morphol. and Biol. of Fungi*, &c. (Eng. trans. Oxford, 1887). Systematic information must be sought in works such as Saccardo's *Sylloge Fungorum*, and the various cryptogamic floras, such as M. C. Cooke's *Handbook of British Fungi* (2d ed. 1887), his *Illustrations of British Fungi* (2d ed. 6 vols. 1884–88), or Stevenson's *Mycologia Scotica* and *Hymenomycetes Britannici*. Leunis, *Synopsis der Pflanzenkunde*, vol. iii., is also of service. For esculent fungi, see Badham, *Esculent Funguses of England* (1863); W. G. Smith, *Mushrooms and Toadstools* (1879).

Fungibles are movable effects which perish by being used, and which are estimated by weight, number, and measure, such as corn, wine, money. Things are fungible when their place can be adequately supplied by other individuals of the same class, as where a sum of money is repaid by means of other coins than those in which it was received. Thus, jewels, paintings, and works of art are not fungibles, because their value differs in each individual of the species without possessing any common standard.

Fungus (Lat., 'a mushroom') is a term applied in pathology and surgery to exuberant granulations or ulcerating tumour-growths when they project somewhat in the form of a mushroom above the surface of the skin or mucous membrane where they are situated. The conditions giving rise to this appearance occur especially in connection with the testicle and the brain. Tumours in which it occurs are frequently cancerous. The name also occurs in pathology in its true botanical sense; for Actinomycosis, Favus, Ringworm (q.v.), &c. are produced by parasitic fungi.

Fungus Melitensis. See CYNOMORIUM.

Funkia, so called after a Prussian botanist and herbalist (1771–1839), and sometimes known in English as Plantain-lilies, a genus of Liliaceæ allied to the day-lilies (Hemerocallis). Since their introduction from China in 1790, the five or six species have been largely and increasingly cultivated, not only in greenhouses, but in shrubberies and borders or rockwork, on account of the remarkable beauty of their masses of large broadly ovate or cordate, often variegated leaves. They are easily propagated by division of the tuberous crown, and thrive best in deep soil well manured.

Funny Bone is really the ulnar nerve, which is in most persons so little protected where it passes behind the internal condyle (the projection of the lower end of the humerus at the inner side) to the forearm, that it is often affected by blows on that part. The tingling sensation which is then felt to shoot down the forearm to the fingers has given rise to the name.

Fur. See FURS.

Fur is the term applied to the incrustation which is formed in the interior of vessels (teakettles, boilers of steam-engines, &c.) when calcareous water has been for a considerable time boiled in them. Many spring waters contain carbonate of lime held in solution by carbonic acid. When this water is boiled, the acid is expelled and the carbonate is deposited, often in association with a little sulphate, forming a lining more or less coherent upon the sides of the vessel. In steam-boilers this may be prevented by the addition of a small quantity of sal-ammoniac (ammonium chloride) to the water; carbonate of ammonia is formed and volatilised, while chloride of calcium remains in solution. This chloride, however, attacks the iron more or less according to its quantity and the other saline constituents of the water; therefore many substitutes are offered, some patented, some sold as secret preparations. The carcass of a pig that has died of disease has been found effectual. It appears to act by greasing the particles of carbonate of lime as they precipitate, and thus forming a loose and easily removable powder instead of a coherent deposit. Any other refuse fatty matter may be used for this purpose. The writer strongly recommends this simple mode of treatment, combined with frequent cleansing.

Furfuramide is closely related to FURFURINE and FURFUROL, and all three substances may be prepared from wood. When this is heated with water under pressure for some time, and the resulting liquor distilled, furfurol, $C_5H_4O_2$, an aromatic oil, with an odour resembling cinnamon and bitter almonds, is obtained. By treatment with ammonia this is converted into furfuramide, $C_{15}H_{12}N_2O_3$, a neutral crystalline body. By boiling this again with a solution of potash, furfurine, an alkaline base having the same composition as, and isomeric with, furfuramide is produced. These substances are of little industrial importance.

Furies. See EUMENIDES.

Furlong (i.e. a furrow long), a measure of length, the eighth part of a mile or 220 yards.

Furlough, a military term signifying temporary leave of absence from service. Non-commissioned officers and private soldiers on furlough must be provided with a pass, or they are liable to be seized and dealt with as deserters.

Furnaces. Furnaces perform one of the most important of functions, and on them largely depend the power and economical efficiency of the steam-engine. Great care and skill, combined with an intimate knowledge of the laws which regulate combustion, must be exercised in the designing and construction of furnaces for steam-boilers. They may be considered as divided into three parts. (1) The fire-chamber, where combustion begins, the fuel is split up into its constituent gases, and the remainder consumed. (2) The combustion-chamber, where combustion of the gases is completed, and the heat applied. (3) The arrangements for the supply of air, and its mixture with the heated gases. In the combustion of fuel there are two leading conditions to be observed—viz. to obtain as complete combustion of the fuel with as little waste of heat as possible, and to apply as much of the heat as is practicable to those parts of the boiler where evaporation will be greatest. These two conditions are somewhat difficult to realise in a furnace, and, while the best method of applying heat is well known, the portion available out of a given quantity bears but a very small proportion to what is lost or wasted under the most favourable circumstances. The supply of air is a most important factor; too much has the effect of chilling and diluting the gases, reducing the temperature of the furnace, and diminishing the force of the draught; while too little causes the gases to escape unconsumed, and results in great waste. The proper supply of air is therefore a very difficult matter to accomplish, especially when there is an ever-varying demand for it, as is the case with solid fuel. Liquid or gaseous fuel does not present the same variation. It has

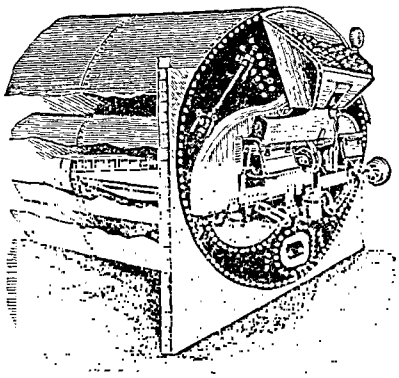


Fig. 1.

been found that the best effect is obtained from furnaces with forced draught—i.e. sending a steady flow of air under pressure through the incandescent fuel by means of a fan or other mechanical contrivance. With the ordinary chimney draught, the heated products of combustion must be allowed to escape at a high temperature, say 600°, and at a speed of about 30 feet per second, in order to maintain an effective draught. With artificial draught, the heat can be retained in the furnace a much longer time, and a balance established between the pressure of the atmosphere and the heat inside. Also the waste heat, instead of rushing away at great velocity, may be made to do work in heating the air for the furnace or the feed-water for the boiler; and is thus allowed to escape only when deprived of its power of doing useful work. The difference in efficiency is said to exceed 25 per cent. in favour of artificial draught.

A good furnace ought to be able to burn a large quantity of coal on a small area of fire-grate. The amount of fuel consumed in different kinds of furnaces varies greatly, and shows the power that forced draught gives. A land-boiler furnace burns about 14 lb. of coal, a marine furnace 16 to 24 lb., and a locomotive, with the draught increased by the escaping steam, from 80 to 200 lb. on the square foot of fire-grate in one hour. The great objects to be desired in furnace management are the exact apportionment of air to the varying wants of the fuel, so as to convert all the carbon to carbonic acid and the hydrogen to water, an equal and high temperature of the furnace, and that the grate-bars be always covered with fuel. Granted these conditions, and we obtain the best effect from the furnace, without smoke. Smoke may be caused by too much as well as too little air, especially with a low temperature in the furnace. Too much air reduces the heat of the furnace and gases below the temperature for combustion, and so smoke is formed. The same result comes from a deficient supply of air to take up all the carbon, a portion of which escapes as smoke. At the same time, with a *high* temperature in the furnace, insufficient air does not cause smoke; carbonic oxide instead of carbonic acid is formed, and one-half of the heat is wasted. In practice, deficient boiler power is a fertile cause of smoke, from having to urge the fire beyond its capacity. Self-feeding furnaces are more economical and efficient than those which are fed by hand. Fig. 1 shows one of the most successful. A large hopper fixed in front of the boiler contains a supply of fuel for a stated period, and requires no further attendance until its contents are consumed. There is an opening at the level of the grate, through which the coals are thrown on to the bars. It is claimed for this self-feeding furnace that it more nearly approaches in regularity firing by hand than any other in use, but there is no smoke when once in operation, and a saving of 10 per cent. in fuel. Figs. 2 and 3 show the best arrangement of flues. The flame on leaving the grate passes through the central tube, descends and returns along the bottom to the front, where it splits and passes on both sides to the chimney. For Blast-furnaces, Siemens's Furnaces, &c., see GLASS, IRON, COPPER, LEAD; see also BOILER, STEAM-ENGINE.

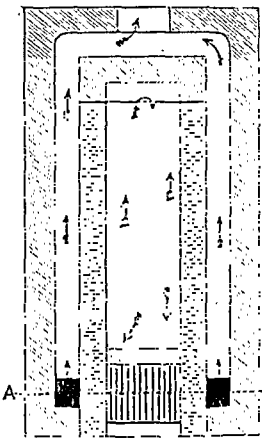


Fig. 2.—Plan of Furnace.

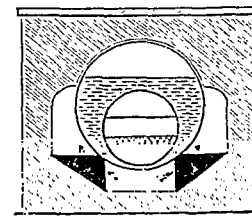


Fig. 3.
Section through AB, fig. 2.

Furneaux Islands, a group of barren islands in Bass Strait, between Australia and Tasmania, Flinders Island being the largest. About 300 people, of mixed breed, earn a living on the islands by the capture of seals and sea-birds. The group takes its name from Furneaux, who discovered it in 1773.

Furnes, a town of Belgium, in West Flanders, 16 miles by rail E. by N. of Dunkirk, has tanneries and linen manufactures. Pop. 5322.

Furness, a district in the north-west of Lancashire, forming a peninsula between Morecambe Bay and the Irish Sea. The chief town is Barrow-in-Furness (q.v.). The ruin of Furness Abbey, 2 miles from Barrow, is one of the finest examples of the transition Norman and Early English architecture in the country. Founded in 1127 for the Benedictines, it afterwards became a Cistercian house. It was long one of the wealthiest abbeys in the kingdom. The civil jurisdiction of the princely abbots of Furness extended beyond the limits of the district of Furness. See J. Richardson's *Furness, Past and Present* (Barrow, 1880).

Furnivall, FREDERICK JAMES, a laborious and enthusiastic student of early English, was born at Egham in Surrey, February 4, 1825, and educated at private schools, University College, London, and Trinity Hall, Cambridge, where he graduated B.A. in 1846, M.A. in 1849. He was called to the Bar in 1849. In early life he associated himself in philanthropic work with Frederick Maurice, &c., taught in the Working Men's College every term for ten years, and was for the same period a captain in its rifle corps. He has devoted himself to English philology, and with characteristic energy has succeeded in founding, for the publication of texts, 'The Early English Text Society,' 1864 (with the 'Extra Series,' 1867); 'The Chaucer Society' (1868); 'The Ballad Society' (1868); the 'New Shakspere Society' (1874); 'The Browning Society' (1881, with Miss Hickey); 'The Wyclif Society' (1882); and 'The Shelley Society' (1886). He has been honorary secretary of the Philological Society since 1854, while he edited for some years the Society's great English Dictionary, the first part of which saw the light under the supervision of Dr Murray in 1884. Through these societies he has raised and expended upwards of £30,000 in printing early MSS. and rare books, and has thus placed in the hands of thousands of students cheap and accurate texts, some score of these well edited by himself. His Robert of Brunne's *Handlyng Synne* and *Chronicle* were edited for the Roxburghe Club and Rolls Series. His most valuable work, however, has been his splendid edition of Chaucer's *Canterbury Tales*: 'A Six-text Print of Chaucer's Canterbury Tales' (7 parts, 1868–75), being an exact print (with the Tales in their proper order and groups) of six of the seven most important MSS.; the seventh he has since printed by itself, besides all the MSS. of Chaucer's Minor Poems. This work has given a new impulse to early English scholarship, and will always remain a monument of the noble and patient enthusiasm of its editor. For the New Shakspere Society he has edited several books of worth in its 'Shakspere's England Series,' specially Harrison's *Description of England* (1577–87) and Stubbes's *Anatomy of Abuses in England* (1583). Of his introduction to the Leopold *Shakspere*, describing the plays and poems in chronological order, over 100,000 copies have been sold. He and a friend built the first narrow wagerboat in England in 1845, and he first introduced sculling fours and eights in 1884 and 1885, and was in the winning crews of the first races ever sculled in these boats. Furnivall was granted in 1884 a Civil List pension of £150. On his sixtieth birthday the university of Berlin conferred on him its Ph.D. degree, *honoris causâ*. In 1881 he prepared a careful bibliography of Browning. In 1888 he edited, with his medical son Percy (a champion cyclist), the first English book on anatomy, which was written by Thomas Vicary in 1548. The series of forty-three fac-similes of the quartos of Shakspere's Plays, edited by Dr Furnivall and scholars under his superintendence, is now drawing to a close.

Furnival's Inn. See INNS OF COURT.

Furruckabad. See FARUKHABAD.

Furs. Under the name of furs may be included the skins of almost all those animals which, for the sake of protection against cold, have for a covering an under layer of a soft, woolly or downy texture, through which grows in most instances an upper one of a more bristly or hairy nature; some by nature possess more of the under coat, and others more of the upper, the proportion varying considerably in different animals and countries. In winter the fur becomes thicker in its growth, thereby improving the quality and value for commercial purposes; young animals too possess thicker coats than full-grown ones. In some instances the under-fur alone is used in manufacturing, whilst the upper hairs are removed—e.g. in the fur-seal.

The more general use of furs in all civilised countries has made the fur-trade of the present day of even greater importance than in those flourishing days when the fur-traders were the chief pioneers of the North American continent: the quantities of many fur-bearing animals have vastly increased, especially of those rather small mammals which seem to thrive and breed quickly in the proximity of settlements; the larger ones, on the other hand, such as bears, beavers, &c., will in course of time, if not protected, become generally reduced in numbers, a fate which seems to have overtaken the buffalo or North American bison.

The chief supply of furs is obtained from Siberia and the northern parts of North America, and, as these tracts are for the greater part of the year frostbound, the fur-bearing animals enjoy a comparatively unmolested life; the fur, therefore, grows thickly during the winter season, and is in its best condition when the animal is trapped in the spring; large quantities also of the smaller sorts are found in the United States; Europe produces immense numbers of common furs, such as rabbits, hares, foxes, &c., besides the more valuable stone and baum (tree) martens, though the larger animals have almost disappeared as the countries have become more and more cleared and inhabited; South America yields nutrias and chinchillas; whilst Australia exports rabbits, opossums, and kangaroos, and Africa monkey and leopard skins. Nearly all fur-skins are brought to the market in the raw or undressed state.

The two leading companies are the Hudson Bay Company (q.v.), established in 1680, and the Alaska Commercial Company, in 1870; the American Fur Company of New York, the North-west Company, and the Russo-American Company of Moscow once held important positions, but they have long since been broken up or amalgamated. The Skinners' Company of London, one of the city companies or guilds, formerly possessed many ancient privileges and rights in connection with the fur-trade, but these are now in abeyance. The collections of furs of the two first-named companies, together with large quantities consigned from numerous private traders, are annually offered in London for public auction in January and March, with a smaller sale in June; periodical sales during the year are held besides of Australian, African, and other fur-skins. Many important fairs take place on the Continent and in Asia, of which the chief are at Leipzig in Germany (at Easter and Michaelmas), Nijni Novgorod and Irbit in Russia, and smaller ones at Frankfort (Germany), Ishim and Kiakhta (both in Siberia).

Following is a list of the principal fur-producing animals, with a few of the most interesting and important facts in connection with them with regard to the fur-trade; the values are those for the raw skins in the year 1889:

Badger (*Taxidea americana*).—The fine-haired kind, used for fur purposes, comes from North America—value, 6d. to 22s.; whilst the coarse bristly-haired skins (*Meles taxus*), utilised for brushes, are imported from Russia, Bosnia, and Bulgaria; value, 2s. to 2s. 6d.

Black Bear (*Ursus americanus*) yields the well-known fur which is seen on the headgear of the Guards; also much esteemed as a general fur, as it is long, black, glossy, and thick. About 14,000 skins are imported annually from Canada, Alaska, and part of the United States, values ranging from 2s. for very common to as much as £14 for best. The Brown or Isabella Bear is a variety of the above, the value considerably higher, and quantity imported much less. The Russian Bear (*Ursus arctos*), the Grizzly Bear (*U. horribilis*) from North America, and the white Polar Bear (*U. maritimus*) from the Arctic regions likewise possess skins of considerable value.

Beaver (*Castor canadensis*) has a rich brown fur, but is more generally known in its 'plucked' or 'unhaired' state (with the long hairs removed); the most valuable are quite black in colour; the fur has besides a good appearance when dyed. In former times beaver fur was used in the manufacture of hats, but is now almost superseded by silk. Exported from North America in quantities of about 150,000 skins annually. Value, from 6s. to 60s., according to quality.

Chinchilla (*Chinchilla lanigera*).—'Real' chinchilla is the finest and most delicate of all furs, extremely soft to the touch, and the colour bluish-gray; the best come from Peru, a good skin being worth 20s. 'Bastard' chinchillas are less valuable, and only worth from 6d. to 2s. apiece.

Ermine (*Mustela erminеus*).—Colour of fur white (in its winter coat), with the exception of the tip of the tail, which is black. The animal is widely distributed; the chief supplies from Siberia. The fur is no longer restricted to royalty as in olden times. Value, about 1s. Miniver is ermine fur with black spots of lamb-skin sewn in.

Fisher or Pekan (*Martes pennanti*).—A North American fur; value, 13s. to 70s. Used almost exclusively by the Russians.

Fitch or Polecat (*Mustela putorius*), from Germany, Holland, and Denmark. Used in England for civic robes. Value, 2s. to 5s.

Blue Fox (*Vulpes lagopus*).—Colour, a more or less brownish-blue, or deep slate at its best. About 3000 skins are imported annually from North America. Value, 45s. to 200s.

Cross Fox (*Canis fulvus*).—Similar to the silver fox, but redder in hue, and there is generally a darker shade of colour across the shoulders, forming a sort of cross, whence the name is derived. This fur too is mostly worn in Russia. Yearly collection about 7000; prices, from 9s. to 111s.

Gray Fox (*C. virginianus*), Kitt Fox (*C. velox*).—Both of a grayish colour, and from North America, the former from the United States; value, 11d. to 4s. 9d., and importation 30,000. Value of the kitt fox about 2s.

Red Fox (*C. fulvus*).—General hue, of a sandy red, although a few from Minnesota are quite light in colour, almost white, others again from Kamchatka are of a brilliant red. Chiefly worn as a fur in Turkey and eastern countries of Europe; about 60,000 to 80,000 skins are collected annually in North America and Kamchatka; prices range from 3s. to 30s. Some 100,000 of a similar but less valuable variety are caught in Europe.

Silver Fox (*C. fulvus*), the rarest of the three varieties of the American fox (in some districts red, cross, and silver foxes are found in the same litter), is principally obtained from Alaska, Columbia, and the Hudson Bay Territory. The colour is silvery black, occasionally brownish, the tip of the tail always white; a perfectly black skin (sometimes termed Black Fox) will fetch up to £55, a silvery one from £11 to £20. The majority are bought by Russia, the annual importation into London being only about 2000 skins.

White Fox (*Vulpes lagopus*) is in natural history the same animal as the Blue Fox, and likewise an expensive fur; a pure white is its finest colour; the discoloured are used for dyeing black, brown, silvery black, and slate blue, the last two in imitation of silver and blue-fox fur. Value, undyed, 4s. to 34s. Quantity annually imported, 6000 to 17,000.

Hare (*Lepus europæus*).—The ordinary gray are from all parts of Europe and largely used for felting purposes; in high latitudes the fur becomes a pure white in winter-time, and a large quantity of this sort is exported from Russia, some of which are dyed to imitate other more valuable furs.

Koala or Australian Bear (*Phascolarctus cinereus*), a common woolly fur, used for rugs, &c.

Kolinsky (*Mustela sibiricus*), a species of marten from Siberia, the tails of which are very valuable for artists' brushes (known as red sable). The colour of the fur is light yellow.

Lambs (*Ovis aries*).—Persian lamb, naturally black, but dyed the same colour to hide the white leather underneath, is worn by ladies and on gentlemen's coat collars, and often wrongly termed Astrakhan, which is a greatly inferior sort of lamb, chiefly worn in Canada, worth only from 1s. to 2s. 6d., whereas a Persian lamb fetches from 7s. to 22s. when dyed. The collection of the latter is about 200,000, and is imported from Persia; the Astrakhan is from Astrakhan in Russia; a similar skin to the Persian lamb, though commoner, is called Shiraz, from Shiraz in South Persia; Bokharens come from Bokhara, Ukrainer lambs from the Ukraine district, and gray Crimmers from the Crimea. Large numbers of white lambs from western Europe and Buenos Ayres are used for glove and boot linings; the white Iceland lamb as a children's fur.

Leopards (*Felis pardus*) are imported from Africa and India for rugs, &c. (value, 10s. to 35s.); tigers too from India (a good skin worth about £4); more valuable and thicker furred varieties of both animals are found in China, values about £7 to £12 and £10 to £60 respectively.

Lynx (*F. canadensis*).—The fur is of a light-brown colour, with a light silvery top on the back, that on the under part, long, soft, and spotted; about 30,000 to 80,000 are imported yearly from the Dominion of Canada, California, and Alaska. Both the annual importation and market price fluctuate considerably. Value, from 10s. to 34s.

Marten (*Martes americanus*).—A good and old-fashioned fur, now slowly recovering its value. The general colour is a rich brown, some skins nearly black, others again quite pale; the fur is light and soft, and generally considered one of the best for wear, appearance, price, and durability; the tails are bushy and much used for muffs, &c., a few utilised for fine artists' brushes. About 100,000 are trapped in North America, the finest in Labrador, East Maine, &c. Prices vary from 6s. to 70s. for very choice; an average price is about 20s. to 30s. Large quantities of Stone Martens (*Mustela foina*) and Baum or Pine Martens (*M. Martes*) are collected in Europe.

Mink (*Mustela Vison*), a water animal inhabiting Canada, the United States, and Alaska; its fur is brown and short, though quite dark in colour and fine in some districts, such as Labrador, Nova Scotia, &c., but light brown and coarse in others. Annual importation, about 300,000 to 400,000; value, from 1s. to 26s. for very prime.

Black Monkey (*Colobus vellerosus*) possesses a long, black, silky fur, its present value being from 3s. to 10s., a fairly high price compared with its usual worth. About 50,000 to 100,000 are imported every year from the west coast of Africa. The Gray Monkey (*Cercopithecus diana*) and a few others come as well from Africa.

Musk-rat or Musquash (*Fiber zibethicus*), a North American fur, about three millions of which are imported yearly, and used in nearly all countries, either 'natural' or 'plucked' and dyed, when it makes a common imitation of seal. The fur was formerly used for felting purposes. A black variety found in Delaware is also used as a fur, but in smaller quantities. Value of former, 6d. to 1s. 9d.

Nutria or Coypu Rat (*Myopotamus coypus*), from South America; the fur when 'unhaired' forms a cheap substitute for beaver. Value, 8d. to 1s. 9d.

Australian Opossum (*Phalangista vulpina*), a fur much in vogue on account of its cheapness and bluish-gray natural tint; many are manufactured when dyed various shades. Some 2,000,000 are imported every year. Price from 6d. to 2s. 3d.

American Opossum (*Didelphys virginiana*), an entirely different fur from the foregoing, with longer upper hairs of a silver-gray colour. Importation, 200,000 to 300,000; value, 1d. to 2s. 5d.

Sea Otter (*Enhydra Lutris*), so abundant some years ago, has now sadly diminished in numbers owing to indiscriminate slaughter in former years, only about 4000 to 5000 being now taken annually at or near the Aleutian Islands. Its skin brings the highest individual price of all furs, and even as much as £155 has been paid for a single skin; ordinary values are from £20 to £70. The fur is dense, rich, rather long, and fine, of a dark-brown colour, the most highly valued skins possessing silvery hairs. Chiefly worn in Russia.

Otter (*Lutra canadensis*) is characterised by the stoutness and density of its fur, which is somewhat short like seal; used in most countries either in the natural state or 'unhaired,' and sometimes dyed. The general colour is from light to dark brown or almost black; the finest skins come from Nova Scotia and Labrador; about 16,000 are imported annually from North America, though otters are found nearly all over the world. Prices range from 9s. to 95s. for best.

Rabbit (*Lepus cuniculus*), from its vast quantities (probably about ten to twenty million skins are used annually), is the most widely known fur in all countries, in all shapes and forms, both 'natural' and dyed; when clipped and dyed it forms an inferior imitation of fur-seal. The greater portion of the Australian importation (about 6000 bales, containing each about 200 dozen) is used for felting in the manufacture of hats, &c.; the fur when cut off for this purpose is termed 'coney-wool.'

Raccoon (*Procyon lotor*) yields a serviceable fur; price from 1s. 6d. to 7s. per skin, the best dark coloured, from 10s. to 20s. The colour is gray or dark gray, often with a brownish-yellow tinge; the fur is widely used in both 'natural' and dyed states. About 400,000 to 500,000 skins are yearly imported from the United States.

Russian Sable (*Mustela zibellina*), the most costly of all furs, considering the small size of the skin; the quality extremely fine. The darkest are the most valuable; the usual colour an umber brown and less red than marten fur. Some of the finest Yakutsk skins have realised up to £28 apiece (wholesale price), but a more ordinary value is from 40s. to 90s. About 5000 to 6000 are sold every year in London, of which many come from Kamchatka and Okhotsk.

Fur-seal (*Callorhinus ursinus*).—The chief supply of the Alaska seal is from the Prybilov Islands in the Behring Sea, where by act of congress the quantity of skins annually taken is restricted to 100,000. Copper Island, Japan, and the adjacent seas produce large quantities of fur-seals; a good number are also taken at Cape Horn and Lobos Island, but the former great fisheries of the South Shetland, &c. seals, in the South Seas, from which the earlier supplies of skins were drawn, are now exhausted; a few of these last rich skins fetched over £10 apiece lately at public auction in London, where the collections of salted fur-seals are brought for sale. In the salted state they are very unsightly and dirty; the first process in their preparation, which is almost entirely carried on in London, is 'blubbering' (removing superfluous fat, &c.), and the subsequent ones, washing, 'unhairing' (i.e. removing the long, coarse, or 'water' hairs), leathering, dyeing, shaving the pelt, and machining, which last takes away all trace of the 'water' hairs, leaving the soft velvety under-fur so well known and justly appreciated.

Various other seals, such as the Common Seal (*Phoca vitulina*), Greenland Se[illegible] Fetid Seal (*P. fetida*), and I[illegible] *phora cristata*), though chiefly of their oil and hides, are made use of in the fur-trade, under the names of Spotted Hair Seals, Bluebacks, and Whitecoats, the two last named when dyed. The Greenland, Fetid, and Hooded seals are taken in large numbers by the Dundee whalers on the ice-floes near Greenland and Newfoundland, and it has been a common delusion that these are fur-seals, which are, however, generally killed on land.

Skunk (*Mephitis mephiticus*) has greatly increased as an article of commerce in the trade since 1880, whereas forty years before it was hardly known to fur-traders, being considered of little or no value from the great drawback in its powerful odour, but this has now to a great extent been overcome. The colour varies from almost white to a rich black, according as the two white stripes are more or less pronounced. About 500,000 to 600,000 skins are trapped in the central parts of the United States, a small quantity in the Dominion of Canada. Value, 6d. to 11s. 6d.

Squirrel (*Sciurus vulgaris*).—About three millions are collected yearly in Siberia and in part of Russia in Europe; the chief trade for dressing the skins and making them into the well-known cloak linings is at Weissenfels in Germany. The tails fetch an enormous price for making into boas; a few too are used for artists' brushes. Values vary from a few pence to about 1s., though the skins are sold in the trade by the hundred.

Wolf.—The finest and largest (*Canis lupus occidentalis*) come from Labrador and the Churchill district; the colour of these is sometimes white or blue, besides the ordinary grizzled colour. Value, 7s. 6d. to 105s., and much esteemed for sleigh robes. A smaller species, the Prairie Wolf (*C. latrans*), is found in larger quantities in the United States; worth only 4s. 6d. to 8s. A large number of the large, coarse Russian Wolf (*C. lupus*) are used as well in the fur-trade.

Wolverine (*Gulo luscus*), a good fur, from Canada, Alaska, and Siberia, of a rather long, coarse description, with a large more or less deep brown 'saddle' mark on its back in the centre of a paler band, with deep brown again beyond. Value, 8s. 6d. to 36s.; quantity annually imported, about 3000.

The usual mode of dressing furs is by steeping them in liquor for a short time, after which the pelts are 'fleshed' over a sharp knife (to get rid of the excess of fat, &c.), and subsequently dried off; they are next trodden by the feet in tubs of warm

sawdust and common butter, by which means the pelt or leather is rendered supple; the skin is finished in dry sawdust, and beaten out.

Certain furs, such as beaver (now to a limited extent), nutria, hare, and rabbit, are used in the manufacture of hats and other felted fabrics, for which purposes the under-fur alone is retained; it is cut off from the pelt, separated from the upper hair, and felted together by means of various machinery (see HAT).

Fürst. See PRINCE.

Fürst, JULIUS, German Orientalist, was born of Jewish parentage, 12th May 1805, at Zerkowo, in Posen. Educated on the strictly orthodox rabbinical and Hebrew literature, he felt constrained, on proceeding to Berlin to study oriental languages and theology in 1825, to discard the intellectual pabulum of his fathers for the more stimulating results of modern scientific investigation. In 1833 he settled as *privat-docent* at Leipzig, and in 1864 became professor of the Aramaic and Talmudic Languages, a post he held down to his death on 9th February 1873. Among his numerous and useful writings may be mentioned *Lehrgebäude der Aramäischen Idiome* (1835); a praiseworthy edition of Buxtorf's Hebrew and Chaldee Concordance (1837–40); *Die Jüdischen Religions-philosophen des Mittelalters* (1845); *Geschichte der Juden in Asien* (1849); *Bibliotheca Judaica* (1849–63); *Hebräisches und Chaldäisches Handwörterbuch* (1851–54; translated by Dr S. Davidson, 5th ed. 1885); and *Geschichte der Biblischen Literatur und des Jüdisch-Hellenischen Schriftthums* (1867–70).

Fürstenwalde, a town of Prussia, on the Spree, 30 miles SE. of Berlin. There are important breweries, a large malting-house, &c. Pop. (1875) 9688; (1885) 11,364.

Fürth, *a manufacturing town of Bavaria, is* situated at the confluence of the Rednitz and the Pegnitz, 5 miles NW. of Nuremberg by the earliest German railway (1835). It is famous for its mirrors, bronze colours, tinsel, lead pencils, combs, optical instruments, metal toys, wares of beaten gold, silver, and other leaf-metal, turnery wares, furniture, stationery, and chicory. The town has also some large breweries, and an extensive foreign trade. Pop. (1875) 27,360; (1885) 35,320, of whom 4664 were Catholics and 3330 Jews. The town was burned to the ground in 1634 and 1680. It fell to Bavaria in 1806.

Fury and Hecla Strait, in 70° N. lat., separates Melville Peninsula from Cockburn Island, and connects Fox Channel with the Gulf of Boothia. It was discovered by Parry in 1822, and named after his ships.

Furze (*Ulex*), a European genus of very branched and thorny shrubs, with linear sharply-pointed leaves, solitary flowers, and two-lipped calyx, belonging to the order Leguminosæ, sub-order Papilionaceæ. The Common Furze (*U. europæus*), also called Whin and Gorse, is common in many of the southern parts of Europe and in Britain, although not reaching any considerable elevation, and often suffering from the frost of severe winters; whereas in mild seasons its flowers may be seen all winter, hence the old proverb, 'Love is *out of season* when the furze is out of blossom.' It is hence scarcely known in any of the northern parts of the Continent; and Linnæus is said to have burst into exclamations of grateful rapture when he first saw Wimbledon Common covered with furze bushes glowing in the profusion of their rich golden flowers. Furze is sometimes planted for hedges, but occupies great breadth of ground without readily acquiring sufficient strength; nor is it thickened by cutting. It affords a wholesome fodder, especially when young, or when its thorns are artificially bruised;

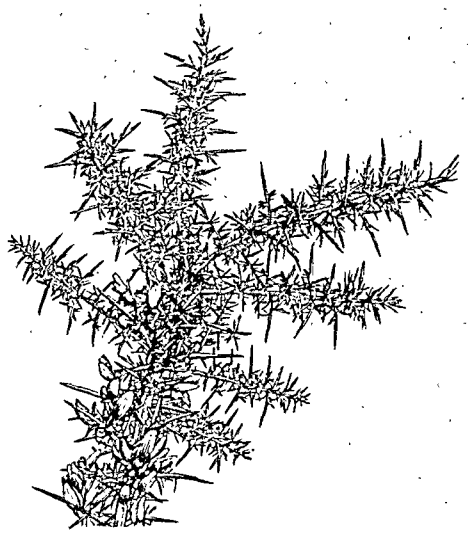


Fig. 1.—Common Furze (*Ulex europæus*).

it is also useful for sheep in winter, and on this account is burned down to the ground by sheep-farmers when its stems become too high and woody, so that a supply of green succulent shoots may be secured. Furze is also esteemed as a cover for rabbits, foxes, &c. A double-flowering variety is common in gardens. A very beautiful variety called Irish Furze (*U. strictus* of some botanists) is remarkable for its dense, compact, and erect branches; the Dwarf Furze (*U. nanus*) is perhaps also a mere variety.

The seedling whin is of interest as bearing two or more ternate leaves just after the cotyledons. These are followed by simple leaves, as in a shoot of broom, and thereafter the characteristic spiny leaves and branches soon begin to appear (see fig. 2, and compare those of seedlings in ACACIA).

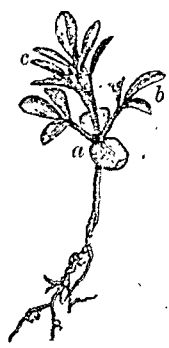


Fig. 2. Seedling Furze: *a*, cotyledons; *b*, first pair of leaves; ternate; *c*, succeeding leaves, simple.

Fusan, one of the three open ports of Corea, on the south-east shore of the peninsula, is practically a Japanese settlement, under a treaty of 1876. The trade is almost entirely in their hands, and in 1888, of 2614 foreigners, they numbered 2595. The imports in 1887 (chiefly Manchester goods, salt, and Japanese wares) were valued at 659,000 dollars, the exports (rice, beans, hides, &c.), excluding specie, at 394,000 dollars. There are good custom stores, and regular communication by steamers with Shanghai, Nagasaki, and Vladivostok, and by telegraph with Seoul.

Fusaro, LAKE OF, *a small lake of Italy,* 11 miles W. from Naples, called by the Romans *Acherusia Palus;* it is near the site of the ancient Cumæ, and during the Roman empire its banks were studded with villas. Numerous remains of ma[illegible] tombs are still to be see[illegible] the water of the lake is [illegible] been cultivated here sin[illegible]

Fuse, Fusee. See FUZE.

Fusel or **Fousel Oil,** known also as POTATO SPIRIT, is a frequent impurity in spirits distilled from fermented potatoes, barley, rye, &c., to which it communicates a peculiar and offensive odour and taste, and an unwholesome property. Being less volatile than either alcohol or water, it accumulates in the last portions of the distilled liquor. It is principally formed in the fermentation of alkaline or neutral liquids, but does not occur in acidulous fermenting fluids which contain tartaric, racemic, or citric acid. It mainly consists of a substance to which chemists have given the name of amylic alcohol, whose composition is represented by the formula $C_5H_{12}O$. It is a colourless limpid fluid, which has a persistent and oppressive odour and a burning taste. It is only sparingly soluble in water, but may be mixed with alcohol, ether, and the essential oils in all proportions. Any whisky which produces a milky appearance, when mixed with four or five times its volume of water, may be suspected to contain it. Fusel oil is principally sold in Britain for the purpose of yielding pear essence (amylic acetate) for the so-called jargonelle-drops. See ALCOHOL, WHISKY.

Fu'seli, HENRY, or more properly Johann Heinrich Füssli, a portrait-painter and art-critic, was born at Zurich, 7th February 1742. In the course of a visit to England he became acquainted in 1767 with Sir Joshua Reynolds, who encouraged him to devote himself to painting. Accordingly he proceeded to Italy in 1770, where he remained for eight years, studying in particular the works of Michael Angelo, and enjoying the society of Winckelmann and Mengs. After his return to England he was elected in 1790 a member of the Royal Academy, where, nine years later, he became professor of Painting. He died at Putney, near London, 16th April 1825. His paintings, some 200 in number, include 'The Nightmare' (1781), and two series to illustrate Shakespeare's and Milton's works respectively. As a painter Fuseli was bold in conception, his imagination reaching up to the loftiest levels of ideal invention; his figures were full of life and energy; and his pictures were often wrought under the poetic inspiration of the mystery of the supernatural. They are, however, too frequently deficient in careful workmanship, the execution having been hurried and rash. His *Lectures on Painters* (1820) contain some of the best art-criticism in the English language. His literary works, with a narrative of his life, were published by Knowles (3 vols. Lond. 1831).

Fusible Metal, an alloy which melts at a temperature below that of boiling water. It consists of a mixture of several metals, of which bismuth is the most important. The following are examples:

Composition.	Melts at
4 bismuth, 2 lead, 1 tin, and 1 cadmium	60·5° C. (141° F.).
5 bismuth, 3 lead, and 1 tin	91·6° C. (197° F.).
8 bismuth, 5 lead, and 3 tin	94·5° C. (202° F.).

Both on account of its melting at a low temperature and of its property of expanding as it cools, fusible metal is valuable for several purposes in the arts. It is used in stereotyping, in taking casts of medals and of woodcuts, and in testing the finish of dies. It has also been employed for making anatomical casts, and a peculiar kind of it was used for making safety-plugs for steam-boilers. For the latter purpose it melts when the pressure of the steam becomes dangerously high. It was found, however, that the alloy underwent some change, by being kept long heated to near its melting-point, which rendered it unsuitable.

Fusiliers were formerly soldiers armed with a lighter fusil or musket than the rest of the army; but at present all regiments of foot carry the same pattern of rifle. Fusilier is therefore simply an historical title borne by a few regiments of the British army—viz. the Northumberland, Royal, Lancashire, Royal Scots, Royal Welsh, Royal Inniskilling, Royal Irish, Royal Munster, Royal Dublin, besides regiments in the native army of British India.

Fusion, Fusibility. See MELTING-POINT.

Fusiyama (properly *Fuji-san*), a sacred volcano, the loftiest mountain of Japan, stands on the main island, about 60 miles SW. of Tokio, and rises some 12,200 feet above sea-level, with a crater 500 feet deep. Its last eruption was in 1707. The cone is free from snow only in July—September, when thousands of white-robed Buddhist pilgrims make the ascent easily enough.

Fust, JOHANN, with Gutenberg and Schöffer formed the so-called 'Grand Typographical Triumvirate' at Mainz between 1450 and 1466. Dr Faust (q.v.) has sometimes been confounded with him. See PRINTING.

Fustel de Coulanges, NUMA DENIS, was born at Paris 18th March 1830, and after filling chairs successively at Amiens, Paris, and Strasburg, was transferred in 1875 to the École Normale at Paris, and became a member of the Institute in the same year. He died September 12, 1889. His earlier writings, *Mémoire sur l'île de Chio* (1857) and *Polybe, ou la Grèce conquise par les Romains* (1858), had hardly prepared the reading public for the altogether exceptional importance of his brilliant book *La Cité antique* (1864; 10th ed. 1885), which threw a flood of fresh light on the social and religious institutions of antiquity. The work was crowned by the French Academy, as was also his profoundly learned and luminous *Histoire des Institutions politiques de l'ancienne France* (vol. i. 1875).

Fustian is a name given to certain kinds of heavy cotton fabrics, including moleskin, velveret, velveteen, beaverteen, corduroy, and other varieties. They are chiefly used for men's apparel, and are nearly all of the nature of velvet, but in the case of corduroy the loops forming the pile are uncut. Fustian cloth with a velvet pile is first woven on the loom, after which the surface weft threads are successively cut, brushed, or teazled, and singed on a hot iron cylinder. The cloth is then bleached and dyed. According to the particular kind of fustian, the face is cropped or shorn either before or after it is dyed. See VELVET.

Fustic. The dyestuff sometimes termed *Old Fustic* is the wood of *Maclura tinctoria*, but the tree is also called *Morus tinctoria*. It is a native of Brazil, Mexico, and the West Indies. Formerly this dye-wood or its extract was largely used for dyeing wool yellow, or for the yellow portion of compound colours, but, like most other vegetable dyes, its importance has declined owing to the preference now given to coal-tar colours. The name *Young Fustic* is occasionally given to the wood of *Rhus cotinus*, the twigs and leaves of which yield a yellow dye, but are much more extensively used as a tanning material. See SUMACH, DYEING.

Fusus, or SPINDLE-SHELL, a genus of Gasteropods, usually referred to the Murex family. The elevated spire, the large last whorl, the canal for the respiratory siphon, are familiar in the 'roaring buckie' (*F.* or *Neptunea antiquus*), to which, as Wordsworth tells us, the curious child applies his ear and listens for the sonorous cadences of the native sea. This common species is often dredged with oysters, &c., and used for bait, or even eaten. The shell, generally about 6 inches long, is or was used for a lamp in the cottages of the Shetland

fishermen. The nests or egg-cases are curious, like those of the Whelk (q.v.). The distribution of Fusus is world-wide; the living species number about 250; the extinct forms are twice as numerous. They began in the middle Jurassic, and reached a climax in the Eocene and Miocene. Other interesting species besides the 'roaring buckie' are *F. colus*, with a siphon-canal twice as long as the shell; *F. colosseus*, about a foot in length; *F. turtoni*, from Scarborough, one of the treasures of conchologists. See WHELK.

Futehgunge, and other Indian towns in *Fut.* See FATEHGANJ, &c.

Future State. See ESCHATOLOGY.

Fuze, a means of igniting an explosive at the required instant, whether it is used in blasting operations, military demolitions and mines, or as the bursting-charge of a shell or Bomb (q.v.). In the former cases electricity would generally be used, but for hasty military demolitions Bickford's fuze is employed in the British army. It is of two kinds—'instantaneous' and 'ordinary,' the first burning at 30 feet a second, the other at 3 feet a minute. The 'ordinary' consists of a train of gunpowder in layers of tape covered with gutta-percha; in the 'instantaneous,' which is distinguished by crossed threads of orange worsted outside, quickmatch takes the place of the gunpowder. Powder hose is sometimes used when no other fuze is available. It is made of strips of linen, forming, when filled with powder, what is called a 'sausage,' ½ to 1 inch in diameter.

The fuzes used for shells are of a totally different character and of many patterns. They are of two classes, those which depend for their action upon the rate of burning of the composition in them, called 'time'-fuzes, and those which burst the shell on its striking the target, ground, or water, called 'percussion'-fuzes. In the British army time-fuzes are hollow truncated cones of beechwood, carrying a column of fuze-composition which burns at a fixed rate—marks and figures on the outside show twentieths of a second or less, and indicate where the hole must be made by a fuze-borer in order that the flame may have access through it to the bursting-charge, and so open the shell at the desired instant during its flight. They are chiefly used with Shrapnel Shell (q.v.) and mortars. Their length varies from 3 to 6 inches, and they are fixed in to the head of the shell before firing. The thickness of iron would prevent the passage of the flame through the hole made by the borer in the shorter fuzes, and therefore two or more powder channels are made in them, parallel to the fuze-composition, to communicate its flame to the bursting-charge. In guns having windage the fuze is ignited by the flame of the cartridge enveloping the shell, and quickmatch is placed on the top of the fuze to facilitate this. A metal cover protects the quickmatch until the last moment, and is then torn off by means of a tape provided for that purpose. In guns having no windage a percussion arrangement is placed in the head of the fuze, so that the shock of discharge may ignite the fuze-composition. Fig. 1 shows a section of the common time-fuze, through one powder channel. A section of the percussion-fuze designed in the Royal Laboratory at Woolwich is shown in fig. 2. It is a hollow gun-metal cylinder, *a*, arranged so as to screw into the head of the shell. Inside is a movable *pellet* or ring, *b*, of white metal driven with fuze-composition like a tube, and carrying a percussion-cap. It has four *feathers* or shoulders projecting from its sides, and above these a gun-metal *guard*, *c*, fits round the pellet loosely, so as to prevent the cap of the pellet coming into contact with a steel pin which projects downwards from the top of the fuze. A safety pin, *d*, goes through the fuze with the same object, but is removed before firing, and a lead pellet, *e*, then closes the aperture left by its removal. On discharge the shock causes the guard to shear off the feathers, and set back with the pellet against the bottom of the fuze. The shock of impact on the target or ground causes the pellet to set forward, bringing the cap against the pin, igniting the fuze-composition, and bursting the shell. Percussion-fuzes are chiefly used with 'common' Shell (q.v.). Very many others are in use, chiefly modifications of these two types—e.g. the 'delay' action fuze has both a percussion and time arrangement, so as to burst the shell an instant after impact. All are delicate and apt to deteriorate hopelessly with age or exposure to damp. In the American pneumatic dynamite gun, the shell contains an electric battery, and the circuit is completed by the shell striking either water or the target.

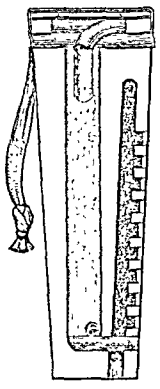


Fig. 1.

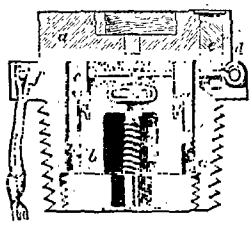


Fig. 2.

Fyne, LOCH, a sea-loch of Argyllshire, running 40 miles northward and north-eastward from the Sound of Bute to beyond Inveraray. It is 1 to 5 miles broad, and 40 to 70 fathoms deep. On the west side it sends off Loch Gilp (2¾ × 1¾ miles) leading to the Crinan Canal. Loch Fyne is celebrated for its herrings.

Fyrd, the old English Militia.

Fyzabad (better *Faizabad*), a city of Oudh, on the Gogra, 78 miles E. of Lucknow by rail. Built on part of the site of Ajodhya (q.v.), it was the capital of Oudh from 1760 to 1780, but is now greatly fallen from its old-time splendour, most of its Mohammedan buildings being in decay, and its palace converted into a storehouse for opium. It maintains, however, an active trade, especially in wheat and rice. Pop. (1881) including cantonments, 43,927.—The area of Fyzabad *district* is 1689 sq. m., with 1,081,419 inhabitants; of Fyzabad *division*, 7305 sq. m., with a pop. of 3,230,393. For the capital of Badakhshan, see FAIZABAD.

G

is the seventh letter in the Roman alphabet, and in the modern alphabets derived from it. For the history of the character, and its differentiation out of C, see ALPHABET and letter C. The earliest inscription in which G is found is the epitaph on Scipio Barbatus, which Ritschl considers was inscribed not later than 234 B.C. The substitution of G in the Roman alphabet for the disused letter Z, which occupied the seventh place in the old Italic alphabet, is believed to have been effected in the school of Spurius Carvilius, a grammarian who lived at the close of the 3d century B.C. In our minuscule g, which is derived from the Caroline script, the two loops do not belong to the majuscule form G, of which the little crook at the top of g is the sole survival. In Latin the sound of *g*, as in *gaudeo*, *genus*, *age*, was always hard, as in the English *got;* our soft sound, which is heard before *e* and *i* in *gist*, *generous*, and *gentle*, did not come into use in Latin before the 6th century A.D. In English this soft sound is confined to words of foreign origin, such as *gem* and *gender*, and is due to French influence. An initial *g* in words of English origin is always hard, even before *e*, *i*, and *y*, as in *gave*, *get*, *give*, and *go*.

The Normans could not sound our *w*, and substituted for it *gu*. Hence we have such doublets as *guardian* and *warden*, *guarantee* and *warranty*. Conversely a French *g* sometimes becomes *w* in English. Thus the old French *gauffre* has given us our word *wafer*. G is often softened to *y*, *e*, *i*, or *a*. Thus Old English *genoh* is now *enough*, *gelic* is *alike*, *git* is *yet*, *geong* is *young*, *handgeweorc* is *handiwork*, *sælig* is *silly*. A final or medial *g* often becomes *w* or *ow;* thus the Old English *fugol* is now *fowl*, *maga* is *maw*, *sorg* is *sorrow*, *lagu* is *law*, *elnboga* is *elbow*. Sometimes *g* disappears altogether, as in the Old English *gif*, which is now *if;* *is-gicel*, which is *icicle;* or *magister*, which is *master* and *mister*. Before *n* we occasionally have an intrusive *g*, as in the words *foreign*, *feign*, *sovereign*, and *impregnable*. An Old English *h* sometimes becomes *gh*, and then lapses to *f*, as in *enough* and *draught*. In the case of many words, such as *gate*, *get*, and *again*, we owe to Caxton, under Mercian influences, the restoration of the Old English *g*, which for three hundred years had in Wessex been gradually lapsing into *y*.

Gabbro (Ital.), a rock consisting essentially of the two minerals plagioclase Felspar (q.v.) and Diallage (q.v.). It shows a thoroughly crystalline granitoid texture, with no trace of any base. The plagioclase is a basic variety—labradorite being commonest, but anorthite is also sometimes present in abundance. The diallage may usually be noted by the pearly or metalloidal lustre on its cleavage-planes. It is usually either brownish or dirty green in colour. Olivine is also often met with as a constituent of gabbro, and some apatite is almost invariably present. In certain kinds of gabbro other varieties of pyroxene appear; and amongst other minerals which occasionally occur in gabbro may be mentioned hornblende, magnesia-mica, magnetite, ilmenite, quartz. The rock is of igneous origin, and occurs in association with the crystalline schists as large amorphous masses or bosses. Sometimes also it appears in the form of thick sheets and bosses associated with volcanic eruptive rocks.

Gabelentz, HANS CONON VON DER, German philologist, was born at Altenburg, 13th October 1807. Even whilst still a student at Leipzig and Göttingen he spent a large part of his time in the study of Chinese and Arabic. He then began to study the Finno-Tartaric languages, and published in 1833 his *Elémcnts de la Grammaire Mandschoue.* He had, moreover, a share in the establishment (1837) of *Zeitschrift für die Kunde des Morgenlandes*, a journal devoted to oriental science, and contributed to it some interesting papers on the Mongolian and Mordvinian languages. Along with J. Löbe he published a critical edition of the Gothic translation of the Bible by Ulfilas, with a Latin translation, and with a Gothic glossary and grammar appended (1843–46). Besides a grammar of Syrjan (a Finnish dialect, 1841), he furnished contributions to periodicals on the Swahili, Hazara, Formosan, and Samoyede languages. His most important work on the science of language is *Die Melanesischen Sprachen* (2 vols. 1860–73). *Beiträge zur Sprachenkunde* (1852) contains Dyak, Dakota, and Kiriri grammars, whilst *Ueber das Passivum* (1860) is a treatise on universal grammar. In 1864 he published a Manchu translation of the Chinese works, *Sse-chu*, *Shu-king*, and *Shi-king*, along with a glossary in German. Gabelentz knew upwards of eighty languages. He died 3d September 1874 at Lemnitz in Saxe-Weimar.—His son and namesake, likewise a philologist, was born in 1840, and in 1878 was called to a chair of Eastern Asiatic Languages at Leipzig.

Gabelle (derived through Low Lat. *gabulum* from the Old Ger. *gifan* or Gothic *giban*, 'to give'), in France a word sometimes used in a general way to designate every kind of indirect tax, but more especially the tax upon salt. This impost, first levied in 1286, in the reign of Philippe IV., was meant to be only temporary, but was declared perpetual by Charles V. It varied in the different provinces. It was unpopular from the very first, and the attempt to collect it occasioned frequent disturbances. It was finally suppressed in 1789. The word also indicated the magazine in which salt was stored. The name *gabelou* is still given by the common people in France to custom-house officers and tax-gatherers.

Gabelsberger, FRANZ XAVER, the inventor of the system of shorthand most extensively used in German-speaking countries, was born 9th February 1789 at Munich, and entered the Bavarian civil service, acting as ministerial secretary in the statistical office of the finance department from 1826 to the date of his death, 4th January 1849. The summoning of a parliament for Bavaria in 1819 led Gabelsberger to adapt the shorthand

system which he had invented for his own private use to the purpose of reporting the proceedings of the parliament. Discarding straight lines and sharp angles, he endeavoured to construct a series of signs which should conform as closely as possible to the written signs of German, and for his models went back to the majuscule forms of the so-called Tironian signs employed in Latin. His system is now used for reporting parliamentary proceedings in most of the countries in which German is the official language; and it has also been adapted to the languages of several countries outside of Germany. Gabelsberger published an account of his system in *Anleitung zur Deutschen Redezeichenkunst oder Stenographie* (2d ed. 1850). See Gerber, *Gabelsbergers Leben und Streben* (1868).

Gaberlunzie, an old Scotch term for a beggar, from his wallet. The word is no doubt originally of the same origin as the English *gabardine*, 'a cloak,' from the Spanish *gaban;* the second part the same as *loin*, the part on which the wallet rests. There is extant a fine old ballad of a young lover who gained access to his mistress through adopting the disguise of the gaberlunzie-man.

Gabes. See CABES.

Gabion (Ital. *gabbia*, related to Lat. *cavea*, 'hollow'), a hollow cylinder of basket-work, 3 feet high and 2 in diameter, employed in fortification for revetting purposes—i.e. to retain earth at a steep slope. A *sap-roller* consists of two concentric gabions, one 4 feet, the other 2 feet 8 inches in diameter, the space between being wedged full of pickets of hard wood, so as to form a movable protection for the men working at a saphead. See MINES.

Gabirol. See AVICEBRON.

Gable, the triangular part of an exterior wall of a building between the top of the side-walls and the slopes of the roof. The gable is one of the most common and characteristic features of Gothic architecture. The end walls of classic buildings had Pediments (q.v.), which followed the slope of the roofs, but these were always low in pitch. In medieval architecture gables of every angle are used with the utmost freedom, and when covered with the moulded and crocketed copes of the richer periods of the style, they give great variety and beauty of outline.

Gablets, or small gables, are used in great profusion in connection with the more decorative parts of Gothic architecture, such as canopies, pinnacles, &c., where they are introduced in endless variety along with tracery, crockets, and other enrichments.

The towns of the middle ages had almost all the gables of the houses turned towards the streets, producing great diversity and picturesqueness of effect, as may still be seen in many towns which have been little modernised. The towns of Belgium and Germany especially still retain this medieval arrangement. In the later Gothic and the Renaissance periods the simple outline of the gable became stepped and broken in the most fantastic manner. This method of finishing gables has again become popular, all sorts of curves and twists being adopted. See CORBIE-STEPS.

Gablonz, a town of the north of Bohemia, 6 miles SE. of Reichenberg, celebrated for its glass manufactures, in which some 12,000 men are employed. The town has also textile industries, bookbinding, and porcelain-painting. Pop. 9032.

Gaboon, a French colony on the west coast of Africa between the Atlantic and the middle Congo. Its north boundary touches the German colony of the Cameroons; its south boundary is formed by the river Tshiloango and the water-parting between the Congo and the Kwilu. Its area is estimated at 173,700 sq. m. The coast is tolerably uniform, the principal indentations being Corisco Bay and the estuaries of the Gaboon and Ogowé (q.v.) in the north-west. These last are with the Kwilu (q.v.) the principal rivers of the colony. The Gaboon, 10 miles wide at its entrance, penetrates 40 miles inland, with a width varying between 6 and 12 miles. On the north bank, which is tolerably high, is the European settlement of Libreville; the south bank is low and marshy. Its chief affluents are the Como or Olombo from the east and the Remboe from the south. Besides these the Licona, Alima, and Lefini, about which but little is known, flow eastwards into the Congo. The climate on the coastal strip is extremely unhealthy; mean annual temperature, 83° F. On the inland plateau (2600 feet above sea-level) it is better. The interior has not yet been fully explored; certain parts, as the basin of the Ogowé, the region around the sources of the Licona, the Kwilu region, and the coast-lands, are fertile and rich in natural resources. Amongst the exports figure timber, gum, ivory, gutta-percha, palm oil and kernels, earth-nuts, sesamum, and malachite; other products are brown hematite, quicksilver, sugar-cane, cotton, and bananas. The principal imports are salt, spirits, gunpowder, guns, tobacco, cotton goods, and iron and brass wares. All agricultural operations are performed by women. The coast tribes engage in trade, which is particularly active around Loango in the south-west and on the Gaboon. The people belong for the most part to tribes of the Bantu stock, the more important being the Mpongwe, the Fans, Bakele, Bateke, &c. Sheep and goats are numerous, but the former yield no wool. This part of Africa was discovered by the Spaniards in the 15th century. The French made their first settlement on the Gaboon estuary in 1842; twenty years later they extended their sway to the Ogowé. But they seem never to have attached any importance to the colony until after Savorgnan de Brazza (q.v.) began to explore it in 1876–86. By his energy and enterprise the country is being rapidly made known. Administratively the Gaboon districts belong to the colony of Senegambia. See Brun-Renaud, *Les Possessions Françaises de l'Afrique Orientale* (Paris, 1886).

Gaboriau, ÉMILE, the great master of 'police novels,' was born in 1835 at Saujon in Charente-Inférieure, and was only saved from mercantile life by a timely discovery that he could write. He had already contributed to some of the smaller Parisian papers, when he leaped into fame at a single bound with his story *L'Affaire Lerouge* (1866) in the feuilleton to *Le Pays*. It was quickly followed by *Le Dossier 113* (1867), *Le Crime d'Orcival* (1868), *Monsieur Lecoq* (1869), *Les Esclaves de Paris* (1869), *La Vie Infernale* (1870), *La Clique Dorée* (1871), *La Corde au Cou* (1873), *L'Argent des Autres* (1874), and *La Dégringolade* (1876). Gaboriau died suddenly, 28th September 1873.

Gabriel (Heb., 'man of God') is, in the Jewish angelology, one of the seven archangels (see ANGEL). The Mohammedans hold Gabriel in even greater reverence than the Jews; he is called the spirit of truth, and is believed to have dictated the Koran to Mohammed.

Gachard, LOUIS PROSPER, writer on the history of Belgium, was born at Paris, 12th March 1800. He spent the greater part of his life as keeper of the archives at Brussels. He died 24th December 1885. He edited from the national archives of Belgium and Spain the correspondence of William the Silent (1847–58), Philip II. (1848–59), Margaret of Austria (1867–81), and Alba (1850); and wrote *Les Troubles de Gand sous Charles V.*

(1846), and *Retraite et Mort de Charles V.* (1854–55), besides other books dealing with the history of Belgium.

Gad, the seventh son of Jacob by Zilpah, the handmaid of Leah, and founder of an Israelitish tribe numbering at the exodus from Egypt over 40,000 fighting-men. Nomadic by nature, and possessing large herds of cattle, they preferred to remain on the east side of Jordan, and were reluctantly allowed to do so by Joshua, on condition of assisting their countrymen in the conquest and subjugation of Canaan. Their territory lay to the north of that of Reuben, and comprised the mountainous district known as Gilead, through which flowed the brook Jabbok, touching the Sea of Galilee at its northern extremity, and reaching as far east as Rabbath-Ammon. The men of Gad were a stalwart fighting race—eleven of its heroes joined David at his greatest need. Jephthah the Gileadite, Barzillai, Elijah the Tishbite, and Gad 'the seer' were in all probability members of this tribe.

Gadames, or more accurately GHADAMES (the *Cydamus* of the Romans), is the name of an oasis and town of Africa, situated on the northern border of the Sahara, in 30° 9′ N. lat. and 9° 17′ E. long. The entire oasis is surrounded by a wall, which protects it from the sands of the desert. The streets are narrow and dark, being covered in to shield them from the sun's rays. The gardens of Gadames, which grow dates, figs, and apricots, owe their fertility to a hot spring (89° F.), from which the town had its origin. The climate is dry and healthy, though very hot in summer. The town is an entrepôt for manufactures and foreign goods from Tripoli to the interior, and for ivory, beeswax, hides, ostrich-feathers, gold, &c., from the interior to Tripoli. The slave-trade is now completely abolished. Pop. between 7000 and 10,000, mostly of Berber descent, and in religion devoted Mohammedans.

Gad'ara, formerly a flourishing town of Syria, in the Decapolis, a few miles SE. of the Sea of Galilee, but now a group of ruins. It was the capital of Perræa, and in all probability the chief town in the New Testament 'country of the Gadarenes' (cf. Mark, v.). It endured sieges by Alexander Jannæus and Vespasian, but fell into decay after the Mohammedan conquest.

Gaddi, the name of three Florentine painters. (1) GADDO GADDI, born about 1239 at Florence, where he died about 1312. None of his paintings have survived, unless four of the frescoes in the upper church at Assisi are from his hand. Of his mosaics there remain specimens in S. Maria Maggiore at Rome.—(2) TADDEO GADDI, son and pupil of the preceding, was born about 1300 in Florence, and died there after 1366. A disciple of Giotto, he painted frescoes representing the life of the Virgin in the Baroncelli Chapel of the church of the Holy Cross at Florence; a triptych of the Virgin and Child, now at Berlin; another similar one at Naples; and other frescoes at Pisa and Florence. As a painter he possessed little original inspiration.—(3) AGNOLO GADDI, son and pupil of Taddeo, born about 1350, died in October 1396. At Prato he executed a series of frescoes depicting the history of the Virgin's Sacred Girdle, and in the church of the Holy Cross at Florence another series showing the history of the Cross. Besides these he painted some altarpieces. Later in life he settled at Venice, and devoted himself to commercial pursuits.

Gade, NIELS WILHELM, musical composer, born at Copenhagen 22d February 1817. He became known by his *Echoes of Ossian* (1841), studied at Leipzig, and became Mendelssohn's successor as leader of the Gewandhaus concerts there. In 1868 he was appointed master of the Chapel Royal at Copenhagen. He has composed symphonies, an octet, the *Erl King's Daughter*, and other works.

Gades. See CADIZ.

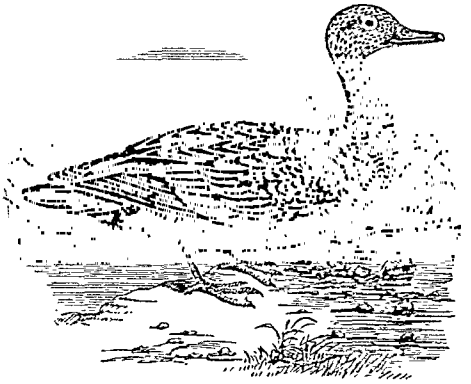
Gad-fly. See BOT.

Gad'idæ (Cod-fishes), an important family of bony fishes in the sub-order Anacanthini (see BONY FISHES), including many of the most important food-fishes, such as cod, haddock, whiting, and other species of Gadus, the hake (Merluccius), the fresh-water burbot (Lota), and the ling (Molva). The general characters will be readily gathered from the articles on these fishes. Most of the Gadidæ are littoral and surface fishes, but not a few, such as Chiasmodus (figured under FISHES), Halargyreus, the deep black Melanonus discovered by the *Challenger*, and Haloporphyrus, inhabit the deep sea, while a few species (e.g. burbot) live in fresh water. They vary greatly in size, from giant cod, hake, and ling four feet or so long to the dwarf-fish (Bregmaceros) of tropical seas, which measures only about three inches. See COD, and similar articles.

Gadsden, CHRISTOPHER, an American patriot, born in Charleston, South Carolina, in 1724, was educated in England, and became a successful merchant in Philadelphia. He was a member of the first Continental congress (1774), rose to the rank of brigadier-general during the revolution, was lieutenant-governor of South Carolina, and suffered nearly a year's imprisonment by the British. He died 28th August 1805.—His grandson, JAMES GADSDEN, born in Charleston, 15th May 1788, served as lieutenant-colonel of engineers in the war of 1812, and as Jackson's aide against the Seminole Indians. In 1853 he was appointed minister to Mexico, and negotiated a treaty under which the United States purchased a large section of territory, 'the Gadsden Purchase,' now forming part of Arizona (q.v.) and New Mexico. He died 25th December 1858.

Gadshill, 3 miles NW. of Rochester, commands a splendid prospect, and was the scene of Falstaff's famous encounter with the growing number of 'rogues in buckram suits.' Gadshill Place, an old-fashioned red-brick house here, which Dickens coveted as a boy, was bought by him in 1856, and was his permanent residence from 1860 till his death in 1870.

Gadwall (*Anas strepera*), a species of duck, not quite so large as the mallard, a rare visitant of Britain, but abundant in many parts of the continent of Europe, and equally so in Asia and in



Gadwall (*Anas strepera*).

North America. Being a bird of passage, it occurs also in tropical regions—e.g. the north of Africa.

It breeds in marshes, and lays from seven to nine eggs. Its voice is loud and harsh. It is much esteemed for the table, and is common in the London market, being imported chiefly from Holland.

Gæa, or GE, in Greek Mythology, the goddess of the earth, appears in Hesiod as the first-born of Chaos, and the mother of Uranus and Pontus. She also bore the Titans, Cyclopes, Erinyes, Giants, &c. As the vapours which were supposed to produce divine inspiration rose from the earth, Gæa came to be regarded as an oracular divinity; the oracles at Delphi and Olympia were believed to have once belonged to her. Her worship extended over all Greece, black female lambs being offered on her altars. She was also the goddess of marriage, and again of death and the lower world. At Rome Gæa was worshipped under the name of *Tellus*.

Gáekwár. See GUICOWAR.

Gaelic Language and Literature. Gaelic is the language of the Goidel or Gael. The term includes Irish and Manx as well as Scottish Gaelic, though popular usage frequently restricts its application to the last alone. The tribes who spoke this language were known to the Romans as *Scoti;* and native authors, especially when they wrote in Latin, sometimes made use of the word to designate the people. Their principal home was in Ireland, and accordingly with writers like Adamnan *Scotia* is 'Ireland,' and *lingua Scotica*, 'Gaelic.' About the beginning of the 6th century a fresh colony of these Scots settled in Argyllshire, and founded the sub-kingdom of Dalriada. They were followed some sixty years later by Columba's mission to Iona. The people prospered in their new home, and by the middle of the 9th century Kenneth MacAlpin, one of their race, became king of Pictland as well as of Dalriada. In after-years the names *Scotia* and *lingua Scotica* followed these successful colonists, and Scotland became the name of the kingdom founded by them. At a later period *Scot* and *Scottis toung* were applied to the Teutonic tribes settled in Scotland and their speech, and then it became customary to speak of Gaelic as *Irish*, or corruptly *Ersch* and *Erse*. But to the people themselves such designations are unknown. With them Scotland has always been *Alba, Albainn*, as distinguished from *Eirinn*, 'Ireland,' and *Sasunn* (Saxon), 'England;' and a Scotsman, whether Celt or Teuton, is *Albannach*. They themselves are *Gaidheil*, 'Gaels,' in contradistinction to *Gaill*, 'strangers,' a word applied of old as a general term to the Norwegian and Danish invaders, but now to the Lowland Scot; their territory is *Gaidhealtachd*, 'Gaeldom,' as distinct from *Galldachd* or 'Lowlands;' and their speech *Gaidhlig*, 'Gaelic,' in contrast to *Beurla*, formerly *Belre*, a word originally signifying 'language' simply, afterwards an 'unknown' or 'foreign tongue,' and now among Highlanders restricted to the foreign tongue best known to them—'English.' When it becomes necessary to differentiate, they speak of *Gaidhlig Albannach*, 'Scottish Gaelic;' *Gaidhlig Eirionnach*, 'Irish Gaelic;' and *Gaidhlig Mhanannach*, 'Manx Gaelic.'

What the language of the tribes occupying the north of Scotland, and collectively spoken of by the Romans as Picts, was, is not definitely ascertained. As in their blood, so in the speech of these people, there was probably a dash of pre-Celtic. That the language was largely a Celtic dialect is proved by such names as *Caledonia*, the root of which we have still in *coill*, in origin as in meaning the equivalent of *holy; Clota*, now *Cluaidh*, 'the Clyde,' a word equated by Whitley Stokes with *cluere*, 'to wash;' *Orcades*, 'isles of *orc*;' or, restoring initial *p*, 'isles of *porc*'—i.e. 'pigs' or 'whales'—a whale being still in Gaelic a 'sea-pig.' The idioms of Pictland in those days seem to have been, in so far as Celtic, more closely allied to the Brythonic than to the Goidelic dialects (see CELTS); but the Dalriads, powerfully backed by the Columban clergy, afterwards made Gaelic the ruling speech over the whole kingdom. It was the language of the court until Malcolm Canmore's day. The political and ecclesiastical ideas which Queen Margaret favoured were hostile to Gaelic, which from her time has been retiring steadily though slowly north and west. We get a glimpse now and again of its retreating footsteps. Gaelic was the vernacular of Buchan in the 12th century, probably much later. The ability to speak the language is one of the accomplishments credited to James IV. by the distinguished Spanish ambassador, Don Pedro Pueblo. It was spoken in Galloway in Queen Mary's reign, and the echoes of the old tongue lingered in the vale of Glenapp down to the close of the 17th century. It was the mother-tongue of George Buchanan, Scotland's greatest scholar, who was born in Killearn in Stirlingshire. Captain Burt mentions that until shortly before the Union, when the farmers of Fife sent their sons as apprentices to the Lothians, it was made a condition of indenture that the boys should be taught English. The sweeping measures taken to punish the Clans who took part in the rebellion of 1745; the introduction of sheep-farming into the north; the spread of education; facilities of communication by steam and rail; the extension of the suffrage—all have in their way been the means of introducing the use of the English tongue into even the remoter parts of the Highlands, though without largely contracting the Gaelic-speaking area. This venerable language is still spoken over the whole of Arran, Argyll, Inverness, Ross, and Sutherland; in considerable portions of Perth and Caithness; and in the upland corners of Dumbarton, Stirling, Aberdeen, and Banff. According to the census of 1881 the number of persons who spoke Gaelic 'habitually' in Scotland was 231,602, of whom, however, no fewer than 8517 were dwellers in Glasgow. Emigrants from the Highlands carried their mother-tongue to America and Australia. In the end of last century Gaelic took root in Carolina; but the use of it in the United States and in Australia is largely on the wane. The language is, however, preached to large and flourishing congregations throughout wide tracts of the Dominion of Canada. Through the exertions of Professor Blackie a Celtic chair was founded in 1882 in the university of Edinburgh; and by the deed of foundation the professor is bound to make 'provision for a practical class in the uses and graces of the Gaelic language, so long as that language shall be a recognised medium of religious instruction in the Highlands of Scotland.'

From the Dalriadic immigration until the Norwegian and Danish invasions, a period of 300 years, Ireland and Gaelic Scotland may be looked upon as one. The language and literature of both were the same. The Norwegian settlement caused a temporary dislocation. The Hebrides were placed under one government with the Isle of Man, and to this day a Manxman finds Gaelic more intelligible than Irish. During this period Scottish Gaelic, separated from the parent tongue, and subjected on the one side to Norse, on the other to Pictish influence, developed certain characteristics which are still traceable. But, when things settled down, the old ecclesiastical and literary relations between the Highlands and Ireland were resumed, and maintained until the Reformation. A common literature checked the tendency of the two dialects to diverge. Accordingly, the differences between Scottish and Irish Gaelic may be regarded as mere variations of dialect, which in the spoken tongues shade into each other. In point of language Ulster is as far removed from Munster as from

Islay. Again, an Islayman feels as much at home in Antrim as in Assynt, and his *patois* differs less from either than that of Liddesdale differs from Buchan. The printed books show greater variations, but these are more in appearance than in reality. Manx is written phonetically, and to a Gaelic reader the page looks strange at first sight. Irish is written as a rule in the old characters, and aspiration is marked by a dot over the letter affected. Gaelic, on the other hand, has adopted the Roman alphabet, and aspiration is indicated, except in the case of infected *l*, *n*, *r*, by the addition of the letter *h*. Irish writers make a liberal use of archaic and obsolete forms, while the aim of Highland authors is to bring the written language and the spoken tongue more into line. In both there has been great loss of inflexion in noun and verb; but on this down grade Scottish Gaelic has progressed even more rapidly than Irish. But in all essential features the two are one language, with a copious vocabulary, the native stores being largely supplemented from foreign sources, especially Latin and English, and with probably an infusion from a pre-Celtic non-Aryan speech. The distinctive Celtic law which places two words that are in close grammatical relation under one main accent, and treats them for the time being phonetically as one word, holds true in all the Celtic dialects, Brythonic and Goidelic alike. Under this law, initial aspiration, due to vocalic *auslaut*, follows the same rules in Irish and Scottish Gaelic; but while the nasal *auslaut*, technically termed eclipsis, proceeds in written Irish with all the regularity of the multiplication table, in spoken Gaelic this phonetic change appears only sporadically, and native grammarians have ignored it altogether.

Among the more noticeable differences between Irish and Scottish Gaelic are the following. In both the accent or stress is on the root-syllable of the word, but Scottish Gaelic exhibits a tendency to follow the English fashion of throwing the accent as far back as possible. Besides, in the case of complex substantives, such as diminutives, &c., which have usually a principal and subsidiary accent, while Irishmen place the main accent on the terminal syllable, Highlanders (and here Ulster joins them) keep the principal accent on the root-syllable. Irish *cnòcán*, 'a hillock,' from *cnoc*, 'a hill,' is in Scotland *cnòcàn;* Irish *dùilleóg*, 'a leaflet,' from *dúille*, 'a leaf,' Gaelic *dùilleag*, &c. Scottish Gaelic, under Norse influence it may well be, takes in many cases the broad sound of *a*, where Irish adheres to the older *o: cos*, 'foot,' is in Scottish Gaelic *cas; focal*, 'vocalis,' *facal*. In the north Highlands the practice is carried further than in the south: *pòg*, 'kiss,' is *pàg* in Sutherland. Even so the open long *e*, sometimes also long *i*, is in the north Highlands diphthongised into *ia*, where south Argyll, like Ireland, is satisfied with the old sound: *fiar* for *fear*, 'grass;' *nial* for *neul*, 'cloud;' so *fian* for *fion*, 'vinum,' &c. With the exception of masculine *o*-stems, the nominative plural of nouns in Scottish Gaelic assumes a final *n*, while Irish abides by the old vocalic ending: Scottish Gaelic *casan*, 'feet,' Irish Gaelic *cosa;* Scottish Gaelic *léintean*, 'shirts,' Irish Gaelic *léinte*, &c. In the verb, Highlanders use the analytic form in some cases where Irishmen have preserved the synthetic. Because of the loss of inflexion, auxiliary verbs in Gaelic as in English have continually to be called in to form mood, tense, and voice. Except in the case of *is*, *ta*, *bheil*, all different roots forming the substantive verb, there is no separate form for the present tense in Gaelic. The *b*-future still survives in both dialects, but the characteristic consonant *f* has disappeared from Scottish Gaelic, and has hardly left its ghost behind: the Irish *cuirfidh* is now simply *cuiridh* in the Highlands.

Gaelic literature in Scotland dates from St Columba. The great missionary was an ardent student and an accomplished scribe; and succeeding abbots of Iona followed in the footsteps of the illustrious founder of the monastery. Ecclesiastics wrote in those days for the most part in Latin. It was a period of great literary activity as well as of missionary enterprise. But of the many works produced at this time few survive. With all his passion for his native saga, the Norseman, in his heathen days, made short work of the books and bells of priests. During the Danish invasions, monks fled in large numbers to the Continent, sometimes taking their MSS. along with them. Accordingly, we find that while only half-a-dozen books written by Gaelic scholars before the 10th century are to be found in the British Isles, there are over 200 MSS. of this period preserved in Austria, Italy, Switzerland, Germany, France, and Belgium. Many of these may have been written in Scotland; two certainly were. A copy of Adamnan's *Life of Columba*, written in Iona before 713 A.D., is now in the public library of Schaffhausen. The Book of Deer, a MS. of the 9th century, is in Cambridge. With the exception of some half-dozen MSS. in the university of Edinburgh, in the library of the Society of Antiquaries, and in private hands, all the MS. literature of the Gael preserved in this country has been, mainly through the influence and patriotism of Dr Skene, deposited for preservation and reference in the library of the Faculty of Advocates, Edinburgh. This collection consists of sixty-three separate parcels, many of them being several MSS. bound together for the convenience of the owner. A large number of them were written within the last 250 years; a few are 500 years old. Many are mere tattered scraps of paper, illegible through damp, decay, and neglect; several are beautiful vellums of exquisite workmanship, as fresh as in the day they were written. About half of the total number are the property of the Highland and Agricultural Society of Scotland. Thirty-two MSS., including nearly all the oldest parchments, are known to have once belonged to the M'Lachlans of Kilbride, in Nether Lorn, Argyllshire. This portion of the collection is supposed to have formed a part of the lost library of Iona.

The greater number of the oldest of these MSS. are indistinguishable from the Irish MSS. of the same date. Since Norse days Scottish Gaelic has had a separate individuality, but of this the MSS. take little or no account. The centre of Gaelic learning and culture was in Ireland and Dalriada. Accordingly, we hear comparatively little of the Pict, his language, beliefs, and traditions. The men of the Isles fought and fell at Bannockburn and Flodden; but though Irish and Norse heroes are household words with Hebridean bards, Bruce and Wallace are unknown to them. In the middle and north Highlands the political sympathy with the central government was not perhaps much stronger than in the west, but the linguistic and literary connection with Ireland was much less close. Accordingly, we find in the MS. of the Dean of Lismore, written by a native of Glenlyon in Perthshire, between 1512 and 1540, and at a later period in the Fernaig MS., written by Duncan M'Rae in Kintail in the latter half of the 17th century, a wide departure from the traditions of Gaelic scholars. Highlandmen and their affairs obtain prominence; the language is not merely Scottish Gaelic, but frequently the provincial idiom of the scribe; the writing is in the current Scottish hand and character of the day; and the orthography

is more or less phonetic, a method adopted partly perhaps in ignorance, partly from impatience, of the strict and highly artificial rules of the schools.

The MSS. in the Scottish collection frequently supply valuable variants, sometimes welcome additions, to the large Irish collections. The subject-matter of several is religious—lives of saints, such as Columba and St Margaret; passions and homilies, such as are found in the *Leabhar Breac*, or 'Speckled Book.' In MS. I. (Skene's catalogue) is the Passion of our Lord as revealed to Anselm, written down in 1467 by Dugald, son of the son of Paul the Scot, a treatise not to be found in the 'Speckled Book.' A few deal with philology and kindred matters. In MS. I., for example, is preserved a copy of the Books of Primers (*Uraicecht nan Eigeis*), as in the Book of Ballymote. Several MSS. contain translations of portions of the heroic history of Greece and Rome: the destruction of Troy, the labours of Hercules, the expedition of Jason; also the wars of Pompey and Cæsar. The genealogies, tales, mythical and legendary, of the peoples and races that inhabited Ireland, and of *Lochlannaich* or Scandinavians, are endless. The most imaginative pieces, such as the voyage of *Maelduin* and the adventures of *Conall*, are in prose, with verse interspersed. Several historical documents and even calendars, such as that of Oengus the Culdee, are, on the other hand, thrown into the form of verse. Gaelic poetry is all lyric, the epic and the drama, as literary forms, being unknown to the people. The line as a rule is smooth and flowing, with an exceeding richness and variety of verse. In poetry as in prose the style is frequently inflated; and the language, whether of praise or blame, unmeasured, exaggerated. The literature shows that the Scottish Gael is witty rather than humorous, and that his perception of the beautiful in external nature is ever lively and true.

The most characteristic features of the Scottish collection are the almost total absence of annals, and the great richness of the medical section. Two folios relating to Irish events (1360–1402) bound up in MS. II., and the history of the Macdonalds of the Isles (MS. L.) are, apart from genealogies, pretty nearly all that deal with affairs within historic times. That records were written in Gaelic we know from various sources, though the memoranda in the Book of Deer and the Islay Charter of 1408 are almost all that survive. On the other hand, fully a third of the whole Scottish collection is medical or quasi-medical. These MSS. consist of treatises on anatomy, physiology, botany, and pharmacy. Several are translations with commentaries of portions of Aristotle's works, of Galen, Hippocrates, Bernardus Gordonus, Averroes, Isidore, &c.; but the strictly medical discussion frequently branches off now to metaphysics and theology, now to astrology and alchemy. The greater part of these scientific documents were at one time the property of the M'Bheaths or Beatons or Bethunes, for many generations family physicians in Islay, Mull, and Skye. These medical books may not perhaps claim to be of great scientific value; but they are of high interest and importance as a most reliable piece of evidence regarding the state of learning and culture in the West Highlands during what we complacently call the dark ages.

The first book printed in a Celtic dialect was John Knox's Liturgy, translated into Gaelic by Bishop Carsewell of Argyll, and published in Edinburgh in 1567. Up to the middle of the 18th century not more than twenty Gaelic books were printed, and these consisted mainly of successive editions of the Psalms, Shorter Catechism, and Confession of Faith. The number of separate publications now amounts to several hundreds. A very complete and accurate account of Gaelic books printed before 1832 is given in Reid's *Bibliotheca Scoto-Celtica*. Professor Blackie, in his *Language and Literature of the Scottish Highlands* (1876), has given admirable translations of the best efforts of modern Gaelic authors. These consist for the most part of a succession of lyric poets who have flourished during the last 300 years. Foremost among them are Mary MacLeod (*nigh'n Alastair Ruaidh*), who was born in Harris in 1569 or thereabouts, and attained, so tradition relates, to the great age of 105 years; John Macdonald (*Iain Lom*) of the Keppoch family, who witnessed the battle of Inverlochy in 1645, and survived Killiecrankie; Alexander Macdonald (*Mac Mhaighstir Alastair*), the celebrated Jacobite poet, born about 1700, received a university education, became schoolmaster in Ardnamurchan, and afterwards an officer in Prince Charles Stuart's army, published a Gaelic vocabulary in 1741, and a volume of poems in 1751; John MacCodrum, a native of North Uist; Robert Mackay (*Rob Donn*, 1714–78), the Reay Country bard; Dugald Buchannan of Rannoch (1716–68), religious poet and evangelist; Duncan Ban M'Intyre (1724–1812), the famous poet-gamekeeper of *Beinn-dòrain*, fought at Falkirk in 1746, and in his old age was a member of the city guard of Edinburgh; William Ross (1762–90), schoolmaster in Gairloch; Allan MacDougall (*Ailean Dall*, 1750–1829); Ewan M'Lachlan of Aberdeen (1775–1822), scholar and poet; and William Livingstone (1808–1870), the Islay bard. Of Gaelic poets still living may be mentioned, among others, the veteran Evan M'Coll of Kingston, Canada; John Campbell of Ledaig; Mrs Mary Mackellar; and Neil Macleod. Of late years the most notable Gaelic works published have been *The Beauties of Gaelic Poetry*, edited by John Mackenzie; *Caraid nan Gaidheal*, being a selection of dialogues and articles contributed by Dr Norman Macleod the elder, the best of Gaelic prose writers, to several periodicals and books; J. F. Campbell's *Tales of the West Highlands* (4 vols. 1860–62), and the same author's *Leabhar na Féinne* or 'Ossianic Ballads' (1872); the *Book of the Dean of Lismore*, edited by Drs M'Lauchlan and Skene (1862); and Sheriff Nicolson's *Gaelic Proverbs* (1881). Scholarly clergymen of a past generation—the Stewarts of Killin, Luss, and Dingwall, and Dr Smith of Campbeltown—made an excellent translation of the Scriptures into Gaelic. The grammars of Stewart and Munro, and the dictionaries of Armstrong (1825) and the Highland Society (1828), though requiring to be rewritten in the light of modern science, are works of great merit. Among the most prominent of recent scholars in the field of Scottish Gaelic were Dr Thomas M'Lauchlan of Edinburgh, Dr Archibald Clerk of Kilmallie, and Dr Alexander Cameron of Brodick. See CELTS, PICTS, OSSIAN, IRELAND, DEER.

Gaeta (Lat. *Caieta*), a strongly fortified maritime town of southern Italy, in the province of Caserta, is picturesquely situated on a lofty promontory projecting into the Mediterranean, 50 miles NW. of Naples. On the summit of the promontory stands the circular Roland's tower, said to be the mausoleum of Lucius Munatius Plancus, the friend of Augustus. The beauty of the bay of Gaeta, which almost rivals that of Naples, has been celebrated by Virgil and Horace. On the dismemberment of the Roman empire, Gaeta became an independent centre of civilisation and commercial prosperity. The town has been besieged on several occasions, as by Alphonso V. of Aragon in 1435, by the Austrians in 1707, by Charles of Naples in 1734, by the French in 1806, by the Austrians in 1815, and by the Italian national party in 1861. In 1848–49 it was the

refuge of Pope Pius IX.; in 1860–61 of Francis II. of Naples. The vicinity of Gaeta abounds in remains of Roman villas, &c. The citadel, which is of great strength, contains in its tower the tomb of the Constable Bourbon, killed at the taking of Rome in 1527. The inhabitants, 16,848 in 1881, are chiefly engaged in fishing and in the coasting trade in corn, oil, wine, and fruits.

Gaeta, MOLA DI: See FORMIA.

Gætulia, an ancient country of Africa, situated south of Mauritania and Numidia, and embracing the western part of the Sahara. Its inhabitants belonged in all probability to the aboriginal Berber family of north and north-western Africa; they were not in general black, though a portion of them dwelling in the extreme south, towards the Niger, had approximated to this colour through intermixture with the natives and from climatic causes, and were called *Melanogætuli*, or 'Black Gætulians.' The Gætulians were savage and warlike, and paid great attention to the rearing of horses. They first came into collision with the Romans during the Jugurthine war, when they served as light-horse in the army of the Numidian king. Cossus Lentulus broke them to Roman rule, obtaining for his success a triumph and the surname of Gætulicus (6 A.D.). The ancient Gætulians are believed to be represented by the modern Tuareg.

Gaff, in a ship or boat, the spar to which the head of a fore-and-aft sail is bent, such sail having its foremost side made fast by rings to the mast, and its lower edge, in most instances, held straight by a boom. The thick end of the gaff is constructed with 'jaws' to pass half round the mast, the other half being enclosed by a rope. A gaff-topsail is a small sail carried on the topmast above the gaff.—For the gaff or hook of the fisherman, see ANGLING.

Gage. See GAUGE; and for GREENGAGE, see PLUM.

Gage, THOMAS, an English general, was born in 1721, the second son of the first Viscount Gage. In 1755 he accompanied Braddock's ill-fated expedition as lieutenant-colonel, and as brigadier-general became in 1760 military governor of Montreal, and in 1763 commander-in-chief of the British forces in America. His inflexible character led the government to regard him as well fitted to end the disturbances in the American colonies. In 1774 he was nominated governor of Massachusetts, a post of peculiar difficulty, and his enforcement of the rigorous decrees of parliament brought matters to a climax. On the night of 18th April 1775 he despatched an expedition to seize a quantity of arms which had been stored at Concord and Lexington; and on the following day the memorable encounter took place which announced to the colonies that the Revolution had begun. The battle of Bunker Hill (q.v.) was followed by Gage's recall, and he returned to England, where he died, 2d April 1787. One of his sons became third viscount.

Gagern, HEINRICH WILHELM AUGUST, FREIHERR VON, German statesman, was born at Baireuth, 20th August 1799. He was one of the founders of the student movement (*Burschenschaft*) of 1815–19. After holding office under the government of Hesse-Darmstadt down to 1848, he became, in that year, one of the leading politicians of the Frankfort parliament, of which he was elected president. In that capacity he endeavoured to carry his views that the new central government for all Germany should be established on the basis of monarchical constitutionalism, and that the king of Prussia was the most fitting monarch to be elected to the dignity of emperor. But, discouraged by the lukewarmness of Prussia, and repelled by the violence of the extreme democratic party, Gagern resigned his position, 20th May 1849, and shortly afterwards retired into private life. But from 1859 he again took part in the grand-ducal politics, as a strong partisan of Austria against Prussia. Pensioned off in 1872, he died at Darmstadt, 22d May 1880.

Gaillac, a town in the French department of Tarn, on the river Gaillac, 32 miles by rail NE. of Toulouse. The abbey church of St Michel dates from the 12th century. Its 6368 inhabitants are engaged in wine-growing, coopering, and spinning, and trade in clover, coriander seeds, plums, and wine.

Gaillard, CHÂTEAU. See ANDELYS.

Gainsborough, a market-town of Lincolnshire, on the right bank of the Trent, 21 miles above its embouchure in the Humber, and 16 miles by rail NW. of Lincoln. The parish church, with the exception of a fine old tower, dating from the 12th century, was rebuilt in 1736. The Manor House, built by John of Gaunt, now forms part of the corn exchange. The grammar-school was founded in 1589. Vessels drawing 12 feet of water can ascend the Trent to Gainsborough, which ranks as a sub-port of Grimsby. The town manufactures linseed cake and oil, malt, and cordage. Pop. (1851) 7506; (1881) 10,873. See Stark's *History of Gainsborough* (2d ed. 1843).

Gainsborough, THOMAS, portrait and landscape painter, one of the greatest of English artists, was born at Sudbury, Suffolk, in 1727, the day of his baptism being the 14th of May. His father, a well-to-do clothier and crapemaker, had him educated at the grammar-school of the place, where Mr Burroughs, the boy's uncle, was master; and, as he was never happy but when sketching the rustic scenery around him, he was sent to London, at the age of fourteen, to study art under Gravelot, the excellent French engraver and designer of book-illustrations, under Frank Hayman, and in the St Martin's Lane Academy. He returned to his native county about 1744, established himself as a portrait-painter at Ipswich, and in 1745 married Margaret Burr, a lady with £200 a year. He was patronised by Sir Philip Thicknesse, the governor of Landguard Fort, a view of which, afterwards engraved by Major, he was commissioned to paint. Through the advice of his friend, he removed in 1760 to Bath, where Thicknesse had influence, and where there was a promising opening for a skilful portrait-painter. Here he won the public by his portrait of Earl Nugent; numerous commissions followed, and in 1761 he began to exhibit with the Society of Artists of Great Britain, in Spring Gardens, London, a body which he continued to support till 1768, when he became a foundation member of the Royal Academy, from which he afterwards practically retired, owing to what he considered the unworthy place that had been assigned to his group of 'The King's Daughters' in the exhibition of 1784. In 1774, after a deadly quarrel with Thicknesse, he removed to London, establishing his studio in a portion of Schomberg House, Pall Mall, and there prosecuted his art with splendid success, being in portraiture the only worthy rival of Reynolds, and in landscape of Wilson. In 1788, while attending the trial of Warren Hastings, in Westminster Hall, he caught a chill from an open window, a cancerous tumour developed itself, and he died on the 2d of August, and was buried in Kew churchyard. Personally, Gainsborough possessed all the enthusiasm, the airy vivacity, the hot impulsiveness, that we commonly associate with the artistic temperament. He was devoted

to art in every form. Fond of company, he loved to associate with players and musicians; he was himself a performer on various instruments, and for him Garrick was 'the greatest creature living, in every respect, worth studying in every action.' Quick of temper, he was also right generous both of hand and heart; and when the long-estranged Reynolds visited him on his death-bed, Gainsborough parted from him with the often-quoted words of perfect brotherhood: 'We are all going to heaven, and Van Dyck is of the company.'

The art of Gainsborough, compared with that of his great contemporary Reynolds, is less scholarly and more instinctive; his portraits show less deep insight into character than those of his rival, but they have perhaps even more of grace, give perhaps even more vivid glimpses of the shifting gesture and expression of the moment. Gainsborough never studied abroad, never left his native country; and though, at various times, he copied from Rubens, Teniers, Vandyke, and Rembrandt, he did so with no merely imitative aim. Nature herself was always before his eye, and nature he interpreted in a manner most individual. His earlier works are firmly and directly handled, with definite combinations of positive colouring; but as his art gained in power he sought more and more for harmony of total effect, for gradation and play of subtly interwoven hues; painting his flesh thinly, but with great certainty of touch, with exquisite refinement of modelling, and with the most delicate transparency in the shadows; and relieving it by the shifting sheen of his draperies, and by backgrounds of swiftly struck, loosely touched foliage, and of softly blending tints of sky. While his landscapes were unduly preferred to his portraits by the—perhaps not unprejudiced—judgment of Reynolds, they too possess admirable artistic qualities, in their freedom of handling and harmony of colour and effect. Though, as Mr Ruskin has truly noted, they are 'rather motives of feeling and colour than earnest studies,' they have still value as faithful records of a distinctly personal impression of nature; and while Richard Wilson developed with delicate skill the traditions of Claude, Gainsborough may, in some sense, be regarded as the forerunner of Constable, as the founder of the freer and more individual landscape art of our own time.

Gainsborough is excellently represented in the National Gallery, London, by fourteen works, including portraits of 'Mrs Siddons,' of 'Orpin the Parish Clerk,' and of 'Ralph Schomberg, M.P.,' and 'The Market Cart,' and 'The Watering-place;' in the National Portrait Gallery, London, by five works; in the Dulwich Gallery by six works, including the portraits of 'Mrs Sheridan' and 'Mrs Tickell;' and in the National Gallery of Scotland by the portrait of the 'Hon. Mrs Graham.' One of his most celebrated portraits is that of Master Jonathan Buttall, known as 'The Blue Boy,' in the collection of the Duke of Westminster. An exhibition of over 200 of his works was brought together in the Grosvenor Gallery, London, in 1885. See the Life by Fulcher (1856), Wedmore's *Studies in English Art* (1876), and Brock-Arnold's *Gainsborough and Constable* (1881).

Gairdner, WILLIAM TENNANT, a distinguished physician, was born in 1824, son of John Gairdner, M.D., F.R.C.S. Edin. (1790–1876), and nephew of William Gairdner (1793–1867), an eminent London physician, and author of a standard work on gout. He graduated M.D. at Edinburgh in 1845, becoming Fellow of the Royal College of Physicians there in 1850, and afterwards LL.D. of Edinburgh and M.D. (*honoris causa*) of Trinity College, Dublin. He was appointed by the crown in 1862 to the chair of Practice of Medicine in Glasgow University, was President of the Medical Association there in 1888, and is physician in ordinary to the Queen for Scotland. He has contributed many valuable papers to the special medical journals, and was an esteemed contributor to the first edition of this Encyclopædia. Among his books are *Pathological Anatomy of Bronchitis and Diseases of the Lungs* (1850), *Notes on Pericarditis* (1861), *Clinical Medicine* (1862), *Public Health in relation to Air and Water* (1862), *On some Modern Aspects of Insanity, Lectures to Practitioners* (in conjunction with Dr J. Coats, 1888), *The Physician as Naturalist* (1889).—JAMES GAIRDNER, historian, a brother of the foregoing, was born at Edinburgh, March 22, 1828, attended lectures in the university there, and at eighteen as a clerk entered the Public Record office in London, where he became assistant-keeper in 1859. He has distinguished himself by the rare combination of profound erudition, patient accuracy, and judicial temper which he has shown in the editing of a long series of historical documents: *Memorials of Henry the Seventh* (1858); *Letters and Papers illustrative of the Reigns of Richard III. and Henry VII.* (2 vols. 1861–63), in the Rolls series; the continuation from vol. v. onwards of the late Professor Brewer's *Calendar of Letters and Papers, Foreign and Domestic, of the Reign of Henry VIII.* (9 vols. 1862–86); and *Historical Collections of a London Citizen* (1876), and *Three Fifteenth-Century Chronicles* (1880), for the Camden Society series. Equally valuable are the books addressed to a wider audience: an edition of the *Paston Letters* in Professor Arber's series (3 vols. 1872–75); *The Houses of Lancaster and York*, in 'Epochs of Modern History' (1874); the *Life and Reign of Richard III.* (1878); *England* in 'Early Chroniclers of Europe' (1879); *Studies in English History* (1881), a series of essays written in conjunction with Spedding; and *Henry VII.*, in the 'Statesmen' series (1889).

Gairloch, an inlet of the sea on the west coast of Ross-shire, 6 miles in length, which gives name to a parish and village. See J. H. Dixon, *The Gairloch* (1888).

Gaisford, THOMAS, D.D., a distinguished classical scholar, was born in 1780 at Ilford, Wilts. He graduated at Christ Church, Oxford, in 1804. He published an elaborate edition of the *Enchiridion* of Hephæstion, was public examiner 1809–10, and in 1811 was appointed regius professor of Greek at Oxford. From 1819 to 1847 he was rector of Westwell, Oxfordshire. In 1831 he became dean of Christ Church. He died in 1855, and in his memory a Greek prize was founded at Oxford. Among his classical publications are an edition of the *Lexicon of Suidas* (1834), and the *Etymologicon Magnum* (1848).

Gaius, a Roman jurist, who flourished between 130 and 180 A.D. Of his personal history next to nothing is known. Before the revision of the Roman laws, and the reform of legal studies by Justinian, the *Institutes* of Gaius, as well as four other of his treatises, were the received text-books of the schools of law. His *Institutes*, moreover, formed the groundwork of the *Institutes* of Justinian. The other works of Gaius, of which we have little more than the titles, were largely used in the compilation of the *Digest*, which contains no fewer than 535 extracts from his writings. The *Institutes* was, like the others, almost completely lost, until in 1816 Niebuhr discovered it at Verona, under a palimpsest of the *Epistles* of Jerome. This discovery threw a flood of light upon the history of the early development of Roman law, especially upon the forms of procedure in civil actions. The first book treated of status and family relations;

the second, of things and of how possession of them may be acquired, including the law relating to wills; the third, of intestate succession and obligations; and the fourth and last, of actions. Alaric II., king of the West Goths, promulgated in 506, for the use of his Roman subjects, the code known as *Breviarium Alarici*, which contains copious excerpts from Gaius. Of numerous editions of the *Institutes* published since 1817, may be mentioned those in fac-simile by Böcking (Leip. 1866) and Studemund (Leip. 1874), and with an English translation by E. Porte (2d ed. Oxford Clarendon Press, 1875) and James Muirhead (Edin. 1880).

Galabat, a small republic of Negroes from Dar-Fûr and Wadai, situated near the western frontiers of Abyssinia. The people, some 20,000 in number, and fanatical Mohammedans, trade with Abyssinia in coffee, cotton, hides, and beeswax.

Galactodendron. See COW-TREE.

Galactometer. See LACTOMETER.

Galacz. See GALATZ.

Galago, a genus of large-eared, long-tailed, African Lemurs (q.v.), arboreal and nocturnal in habit, living on fruit and insects. They vary from the size of a rabbit to that of a rat, are covered with thick soft woolly fur, have somewhat bushy tails longer than the body, and hind-legs longer and stronger than the arms, with two of the ankle bones (*calcaneum* and *navicular*) greatly elongated. The head is round like a cat's; the eyes are large with oval pupils contracting in daylight to vertical slits; the ears are naked and very big, expanded during activity, but rolled together when the animal rests. The digits are strong and well adapted for grasping the branches; all bear nails except the second on the hind-foot, which is clawed. The dentition

Galago Monteiri.

suggests insectivorous rather than vegetarian diet. The female is said to bear one young one at a birth, and often carries it about. Soft nests are also made in the branches. The Galago proper (*G. senegalensis* or *Otolicnus Galago*) is a pretty animal with woolly fur, grayish fawn above, whitish beneath. It seems to be distributed throughout tropical Africa, and is known in Senegal as 'the gum animal' from its frequent habitat in mimosa or gum-acacia forests, and from its alleged habit of gum-chewing. They sleep with bowed head and tail curled round them during the day, but at night they are as active as birds, watching for moths and small animals, on which they spring with great adroitness. They are said to form a favourite article of food in Senegal. The largest species (*G.* or *O. crassicaudatus*) measures a foot in length, not including the bushy tail, which is 15 or 16 inches more. 'In Zanzibar the Komba (*G.* or *O. agisymbanus*) is said frequently to make itself intoxicated with palm-wine, so that it falls from the tree and gets caught.' It is readily tamed and utilised to catch insects and mice in the houses. There are numerous species, sometimes distributed in sub-genera.

Galahad. See GRAIL.

Galangale (*Alpinia galanga;* not to be confused with 'the slender galingale,' see GALINGALE), a genus of Zingiberaceæ cultivated in the Eastern Archipelago, and much used in the East for the same purposes as ginger.

Galanthus. See SNOWDROP.

Galapa'gos (Span. *Galápagos*, from *galápago*, 'a tortoise'), a group of islands of volcanic formation, lying on the equator, about 600 miles W. of Ecuador, to which they belong. The archipelago derives its name from the enormous land tortoises formerly found there in great numbers; but the individual islands all possess names of English origin—probably bestowed by the buccaneers who made them a sort of headquarters during the 17th century. The group consists of seven principal islands, with about half-a-dozen of lesser size, and innumerable islets and rocks; the area is estimated at 2940 sq. m., of which Albemarle Island embraces over half. Rising to a height of nearly 5000 feet, and with a climate dry and somewhat tempered by the cool Peruvian current, the islands are covered with a dense vegetation on the southern side, which absorbs the moisture carried by the trade-wind; on the northern side they are barren and forbidding in aspect, the lower parts covered entirely with ashes and lava or with prickly scrub. Darwin puts the number of craters in the group at 2000; some appear to be not yet extinct. The Galapagos possess both a flora and fauna peculiar to themselves; over a hundred species of plants have been noted that are met with nowhere else, and the species of animals differ greatly even in the various islands. The archipelago was annexed by Ecuador in 1832, and attempts were made to colonise it, of which the only remaining result is the so-called 'wild cattle.' Charles Island was used as a penal settlement for some years, but it and Chatham Island are now occupied by agricultural colonists, the chief crop being sugar. Cotton, vegetables, and most cereals are also raised, and molasses, rum, hides, and Archil (q.v.) are exported. Pop. (1885) 204. See Darwin's *Voyage of the Beagle*, and a paper by Captain Markham in *Proc. Roy. Geog. Soc.* (1880).

Galashiels, the chief seat in Scotland of the Scotch tweed manufacture, occupies 2½ miles of the narrow valley of the Gala, immediately above the junction of that river with the Tweed. Although situated partly in Roxburghshire and partly in Selkirkshire, for judicial purposes it has been fixed by an act passed in 1867 as within the county of Selkirk. It is 33¼ miles SSE. of Edinburgh, and 4 WNW. of Melrose. In the 15th century it is spoken of as 'the forest-steading of Galashiels;' and its tower, demolished about 1814, was then occupied by the Douglases. In 1599 it was made a burgh of barony, having then 400 inhabitants. As early as 1581 wool was here manufactured into cloth, and in 1790 the value of the cloth so manufactured was £1000. So great, however, has been the progress of the woollen trade of the town during the present century, that in 1890 the estimated value of tweeds manufactured was no less than one million and a quarter sterling. By the Reform Act of 1868 it was made a parliamentary burgh, and along with Hawick and Selkirk sends a member to

parliament. A local act of parliament was obtained in 1876, under which the bounds of the burgh were extended for municipal purposes, and a water-supply introduced. Galashiels' chief claim to notice is its manufacturing enterprise. It has 23 woollen factories containing 120 'setts' of carding engines, with 100,562 spindles. The goods manufactured are almost exclusively the well-known woollen cloth called Scotch tweed. The mills are almost entirely dependent on steam for motive power. The town has also the largest and best-appointed skinnery in Scotland. Its valuation rose from £29,838 in 1872 to £62,667 in 1889. Pop. (1831) 2209; (1861) 6433; (1871) 10,312; (1881) 15,330, of whom 12,434 were within the extended burgh. See T. Craig-Brown's *History of Selkirkshire* (1886).

Galata, a suburb of Constantinople (q.v.).

Galatea. See ACIS and PYGMALION.

Galatia, also GALLO-GRÆCIA, in ancient geography, a country of Asia Minor, separated from Bithynia and Paphlagonia on the N. by the Olympus range (Ala-Dagh) and the river Halys, and bounded on the E. by Pontus, on the S. by Cappadocia and Lycaonia, and on the W. by Phrygia. The country is an elevated plateau, 2000 to 3000 feet above sea-level, consisting for the most part of a rolling grassy region, that affords excellent pasturage for sheep and goats. The western half of Galatia is watered by the Sangarius, whilst the Halys traverses it in the middle and north-east. The climate is one presenting extremes of heat and cold. The boundaries of Galatia have, however, varied at different epochs of history. Originally it formed part of Phrygia. The name Galatia it received from a body of Gauls who, breaking off from the army of Brennus, when that chieftain invaded Greece, entered Asia Minor about 278 B.C., and were finally defeated in a great battle by Attalus, king of Pergamus, in 235, who thereupon compelled them to settle in Galatia. Remaining independent, however, they proved formidable foes to the Romans in the wars of the latter against the kings of Syria; and although subdued by the Roman general Cnæus Manlius in 189, they still continued to govern themselves, latterly under a single king. These Gauls, who became Hellenised shortly after settling in their new country, although they clung to their native language down to the 4th century, extended their power during the 1st century B.C. over Pontus, part of Armenia, Lycaonia, Isauria, and other districts. But on the death of King Amyntas in 25 B.C. the country was made a Roman province, which was further divided by Theodosius the Great into Galatia Prima, with Ancyra (Angora) for its capital, and Galatia Secunda, with Pessinus as chief town.

Galatians, THE EPISTLE TO THE, an epistle directed by the apostle Paul 'to the churches of Galatia.' According to Lightfoot it was written from Macedonia or Achaia in the winter or spring of the years 57–58 A.D. Others place it at the end of 55 or the beginning of 56, on the apostle's journey to Ephesus or in the early part of his sojourn there. It is one of the most important of the four epistles which are undoubtedly from the hand of Paul, and was written to counteract the influence of the Judaisers who had appeared among the Gentile Christians of the churches of Galatia. Those churches had been founded by Paul during the second, and revisited by him during the third, of his missionary journeys (cf. Acts, xvi. 6, and xviii. 23). At his first visit the people received him as 'an angel of God,' and he was detained among them by sickness for a considerable time. It is disputed whether the passages i. 9, iv. 16–20, and v. 7, 12 show traces of the Judaising leaven even at the time of his second visit, or whether i. 6, iii. 1, and v. 7, 8 are sufficient to prove that they did not appear till after his departure. As the Roman province of Galatia formed in 25 B.C. included also Isauria, Lycaonia, and parts of Pisidia and Phrygia, some think that the 'churches of Galatia' may have extended to those regions, but it is more probable that the Galatia of Paul was confined to the upper basins of the Halys and Sangarius. Barbarian hordes of *Galati* or *Gallogræci* had settled there in the 3d century B.C., and in the larger towns, like Tavium, Pessinus, and Ancyra, adopted Greek speech and manners, while the country people, down to the time of Jerome, spoke a language 'almost identical with that of the Treveri.' Lightfoot concludes from his elaborate investigations that the Galatian settlers belonged to the Cymric branch of the Celtic race. Though the population included also aboriginal Phrygians, as well as Greek, Roman, and Jewish immigrants, the characteristic vitality of the Celts maintained the predominance of that race, whose proverbial impressibility and fickleness are so clearly illustrated in the epistle to the Galatians. The 'troublers' maintained that every one who entered into God's Covenant must be circumcised, and keep the whole law, whose discipline was a moral necessity for all men, and on whose observance the promises of the Old Testament were dependent. Galatians is the only epistle of Paul which has no word of praise for its recipients. It at once plunges passionately into the immediate practical question—why they are 'so soon removed . . . unto another gospel,' and from beginning to end has no tidings, messages, or greetings. The body of the epistle is commonly divided into two parts—(1) theoretical (i. 6—v. 12) and (2) practical (v. 13—vi. 10). Holsten and others prefer the following division of the argument: (1) the divine origin of Paul's gospel proved by a historical demonstration of the impossibility of its opposite (i. 6—ii. 21); (2) the full right of the believing Gentile to the blessing of the Messianic promise proved by a confutation of the assertion that the Messianic salvation is in any way dependent on circumcision and legal observances (iii. 1—iv. 11); (3) the believer's righteousness of life proved to be the fruit or outward expression of the Spirit bestowed upon him—in contradiction of the supposed necessity of a righteousness of life which should be brought about by subjection to circumcision and law (iv. 12—vi. 10).

The chief commentaries on Galatians are those of Luther (1519; Eng. trans. Lond. 1810); Winer (1821; 4th ed. 1859), Rückert (1833), Schott (1834), De Wette (1841; 3d ed. by W. Möller, 1864); Windischman (Catholic, 1843), Hilgenfeld (1852), Ellicott (1854; 4th ed. 1867), Jowett (1856), Wieseler (1859), Hofmann (1863; 2d ed. 1872), Lightfoot (1865; 5th ed. 1880), Eadie (1869), Brandes (1869), O. Schmoller (1875), Meyer (6th ed. by F. Sieffert, 1880), Holsten in the *Protestantenbibel* (3d ed. 1879; Eng. trans. by F. H. Jones, 1883) and in *Das Evangelium des Paulus* (vol. i. 1880), Schaff (1881), Wörner (1882), Philippi (1884), Köhler (1884), Beet (1885), and Findlay (1888).

Galatina, a town of Italy, 13 miles SW. of Lecce. It has a church, erected in 1384, with antique sculptures and fine tombs of the Balzo-Orsini family. Pop. 8720.

Galatz, or GALACZ, a river-port of Moldavia, the centre of the commerce of the Roumanian kingdom, is situated on the left bank of the Danube, 3 miles below the influx of the Sereth, and 85 from the Sulina mouth of the Danube, whilst by rail it is 166 NE. of Bucharest, and 259 SW. of Odessa. It occupies the slope of a hill overlooking the river, and is divided into an Old and New Town, the former consisting of irregularly built streets, the latter built more after the fashion of western Europe. Its dockyard, its large bazaar,

its grain-stores, its magazines of oriental wares, and its banking establishments deserve notice. The chief objects of industry are iron, copper, wax candles, and soap. The exports consist of maize, wheat, wheat-flour, barley, rye, and timber. The imports include timber, grain, fish, fruits, oil, chemicals, iron, steel, and cotton goods. The town has been, since 1856, the seat of the International Danube Commission. The population, a medley of various nationalities, has risen from 36,000 in 1869 to 80,000 in 1887. Galatz has frequently been taken in the wars between the Russians and Turks since 1789. It ceased to be a free port in 1883.

Gala Water, a stream of Edinburgh, Selkirk, and Roxburgh shires, rising among the Moorfoot Hills, and winding 21 miles south-south-eastward, past Stow and Galashiels, till, after a total descent of 800 feet, it falls into the Tweed, a little below Abbotsford, and 2½ miles W. of Melrose. In its valley, the ancient Wedale, Skene localises one of Arthur's battles; its 'braw, braw lads' are famous in song.

Galaxy (Gr. *gala*, 'milk'), or the Milky-way, is the great luminous band which nightly stretches across the heavens from horizon to horizon, and which is found to form a zone very irregular in outline, but completely encircling the whole sphere almost in a great circle, inclined at an angle of 63° to the equinoctial. At one part of its course it opens up into two branches, one faint and interrupted, the other bright and continuous, which do not reunite till after remaining distinct for about 150°. Its luminosity is due to innumerable multitudes of stars, so distant as to be blended in appearance, and only distinguishable by powerful telescopes. How a collection of stars can assume such appearances as are presented in the Galaxy is explained in the article STARS (q.v.). The investigation of this subject was largely the work of Sir William Herschel. The origin of the current figurative use of galaxy, as in 'galaxy of beauty,' 'galaxy of wit,' is sufficiently obvious.

Galba, SERVIUS SULPICIUS, Roman emperor from June 68 A.D. to January 69, was born 24th December 3 B.C. He was raised to the consulship in 33 A.D., and conducted the administration in Aquitania, Germany, Africa, and Hispania Tarraconensis with courage, skill, and strict justice. In 68 the Gallic legions rose against Nero, and proclaimed Galba emperor. But Galba, now an old man, soon made himself unpopular by placing himself in the hands of greedy favourites, by ill-timed severity, and, above all, by his avarice. Shortly afterwards he was assassinated by the prætorians in Rome.

Galbanum, a gum-resin, used in medicine in the same cases as asafœtida. It is met with in hardened drops or tears, usually compacted into a mass, of a brown to light-green translucent colour, and possessing an aromatic odour and bitter alliaceous taste. Galbanum contains about 7 per cent. of volatile oil, besides resin and gum. It is applied as a plaster to indolent swellings, and occasionally administered as a stimulating expectorant, and in amenorrhœa and chronic rheumatism. Although known from earliest times, and used as an incense by the Israelites (Ex. xxx. 34), under the name of *chelbenah*, its source has always been uncertain. There seems to be little doubt, however, that it is obtained from the *Ferula Galbaniflua* and *F. rubricaulis*, umbelliferous plants found in Persia.

Galchas, a collective name given by Ujfalvy to a group of tribes inhabiting the highlands and upland valleys of Ferghana, the Zarafshan, and the Oxus. They are closely akin to the peoples of the Iranic stock, and in speech are near the Tajiks and Persians. They are Sunni Mohammedans.

Gale, or SWEET GALE (*Myrica gale*), a kindred species to the North American Candleberry (q.v.), and widely distributed through the peaty uplands of the palæarctic world. Its leaves and berries are dotted with resinous oil-drops, which have a most agreeable fragrance, and formerly also gave it a most extensive and varied range of uses in the domestic economy of the Scottish Highlands and other northern countries, for beds, candles, hops, &c.

Gale (*Myrica gale*).

Galen, or CLAUDIUS GALENUS, a celebrated Greek physician, was born at Pergamus, in Mysia, 130 A.D. In his nineteenth year he began the study of medicine, first at Pergamus, afterwards at Smyrna, Corinth, and Alexandria. On his return to his native city in 158 he was at once appointed physician to the school of gladiators. But six years later he went to Rome, where he stayed for about four years, and gained such a reputation that he was offered, though he declined, the post of physician to the emperor. Scarcely, however, had he returned to his native city when he received a summons from the Emperors M. Aurelius and L. Verus to attend them in the Venetian territory, and shortly afterwards he accompanied or followed them to Rome (170). There he remained several years, though how long is not known precisely: at all events he attended M. Aurelius and his two sons, Commodus and Sextus, and about the end of the 2d century was employed by the Emperor Severus. If the statements of one of his Arabic biographers, Abu-'l Faraj, be correct, he must have died in Sicily about the year 201, though the exact place and date of his death are not known with certainty.

Galen was a voluminous writer not only on medical, but also on philosophical subjects, such as logic, ethics, and grammar. The works that are still extant under his name consist of 83 treatises that are acknowledged to be genuine; 19 whose genuineness has been questioned; 45 undoubtedly spurious; 19 fragments; and 15 commentaries on different works of Hippocrates. His most important anatomical and physiological works are *De Anatomicis Administrationibus*, and *De Usu Partium Corporis Humani*. As an anatomist, he combined with patient skill and sober observation as a practical dissector—of lower animals, not of the human body—accuracy of description and clearness of exposition as a writer. He gathered up all the medical knowledge of his time and fixed it on such a firm foundation of truth that it continued to be, as he left it, the authoritative account of the science for centuries. His physiology does not, according to modern ideas, attain to the same level of scientific excellence as his anatomy. He is still dominated by theoretical notions, especially by the Hippocratic four elements (hot, cold, wet, and dry) and the Hippocratic humours. His therapeutics are also influenced by the same notions, drugs having the same four elemental qualities as the human body; and he was a believer in the principle of curing diseases traceable, according to him, to the maladmixture of the elements, by the use of drugs possessing the oppo-

site elementary qualities. His pathology also was very speculative and imperfect. In his diagnosis and prognosis he laid great stress on the pulse, on which subject he may be considered as the first and greatest authority, for all subsequent writers adopted his system without alteration. He likewise placed great confidence in the doctrine of critical days, which he believed to be influenced by the moon. In materia medica his authority was not so high as that of Dioscorides. Numerous ingredients, many of which were probably inert, enter into most of his prescriptions. He seems to place a more implicit faith in amulets than in medicine, and he is supposed by Cullen to be the originator of the anodyne necklace which was so long famous in England. The subsequent Greek and Roman medical writers were mere compilers from his writings; and as soon as his works were translated (in the 9th century) into Arabic they were at once adopted throughout the East to the exclusion of all others.

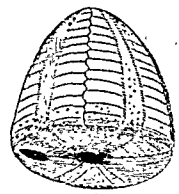
GALENICAL, GALENIST, are words having reference to the controversies of the period of the revival of letters, when the authority of Galen was strongly asserted against all innovations, and particularly against the introduction of chemical, or rather alchemical ideas and methods of treatment into medicine. The Galenists adhered to the ancient formulas, in which drugs were prescribed, either in substance or in the form of tinctures and extracts, &c.; while the chemists professed to extract from them the essences or quintessences (*quinta essentia*, the *fifth* essence, supposed to be particularly pure, as requiring five processes to extract it)—i.e. substances in small bulk, presumed to contain the whole virtues of the original drugs in a state of extreme concentration, or purified from all gross and pernicious or superfluous matter.

There have been numerous editions of Galen's writings, or parts of them; the most accessible, as well as probably the best, is that of C. G. Kühn (20 vols. 1821–33). For a general account of his anatomical and physiological knowledge, see Kidd in vol. vi. of *Trans. Provincial Med. and Surg. Assoc.* (1837); Daremberg, *Des Connaissances de Galien* (Paris, 1841); and the epitome in English by J. R. Coxe (Phila. 1846).

Galena, or LEAD-GLANCE, a mineral which is essentially a sulphide of lead, the proportions being 13·4 sulphur and 86·6 lead; but usually containing a little silver, and sometimes copper, iron, zinc, antimony, or selenium. It has a hardness equal to 2½–3, and a specific gravity of 7·2–7·6. It is of a lead-gray colour, with a metallic lustre, is found massive, or sometimes granular, or crystallised in cubes or octahedrons. It is very easily broken, and its fragments are cubical. It occurs in veins, beds, and imbedded masses, often accompanying other metallic ores, such as zinc-blende, in the older stratified rocks, but most of all in what is known as the carboniferous or mountain-limestone. It is found very abundantly in some parts of Britain, and in many other countries, as in Sweden, Germany, Switzerland, Hungary, France, the United States, &c. Almost all the lead of commerce is obtained from it. It sometimes contains so much silver that the separation of that metal is profitably carried on. The Lead (q.v.) is extracted from it by a very simple process.

Galena, a city of Illinois, on the Fevre River, 6 miles above its junction with the Mississippi, and 133 miles WNW. of Chicago by rail. The river runs here between high limestone bluffs, and the town is built on a series of terraces. It contains a custom-house, and a number of mills, foundries, and furniture factories, and exports a large quantity of lead (mined and smelted in the vicinity) and zinc. Pop. (1870) 7019; (1880) 6451.

Galeri'tes (*galerus*, 'a cap'), a genus of fossil sea-urchins, peculiar to and abundant in the Cretaceous System. The generic name, as well as that popularly given to them in the districts where they abound—viz. 'Sugar-loaves,' is descriptive of the elongated and more or less conical shape of their shell. The body in breadth is nearly circular or polygonal. The under surface is entirely flat, and has the mouth placed in its centre, with the vent near the margin. There are five avenues of pores reaching from the mouth to the summit. These fossils are often found silicified. The species figured is one of the most abundant; it has received its specific name from its resemblance to the white caps worn by the priests of Jupiter.


Galerites albogalerus.

Galerius. Galerius Valerius Maximianus, a Roman emperor, was born of humble parentage, near Sardica, in Dacia. Entering the imperial army, he rose rapidly to the highest ranks. In 292 Diocletian conferred on him the title of Cæsar, and gave him his daughter in marriage. In 296–7 he conducted a campaign against the Persians, in which, though not at first successful, he decisively defeated their king, Narses. On the abdication of Diocletian (305) he and Constantius Chlorus became joint-rulers of the Roman empire, Galerius taking the eastern half. When Constantius died at York (306) the troops in Britain and Gaul immediately transferred their allegiance to his son, Constantine (afterwards Constantine the Great). Galerius, however, retained possession of the east till his death in 311. Galerius was a brave soldier and a skilful commander; but he is believed to have forced Diocletian to issue his famous edict of persecution against the Christians.

Galesburg, a city of Illinois, 53 miles WNW. of Peoria by rail, the centre of a rich agricultural district. It has several foundries, machine-shops, and agricultural manufactories, and is the seat of the Lombard University (Universalist, 1857) and of Knox College (Congregational, 1841). Pop. (1860) 4959; (1880) 11,437.

Galesville, a post-village of Wisconsin, 15 miles ENE. of Winona, with a Methodist university (1855). Pop. 410.

Galgacus, the name Tacitus gives to the Caledonian chief who offered a desperate resistance to the northward march of Agricola (86 A.D.), and was at length disastrously defeated in the great battle of the Grampians.

Galiani, FERDINANDO, an Italian writer on political economy, was born in Chieti, in the Neapolitan province of Abruzzo Citeriore, on 2d December 1728. Although educated for the church, his favourite studies were philosophy, history, archæology, and more especially political economy. He early gained a reputation as a wit by the publication of a volume parodying, in a series of discourses on the death of the public executioner, the principal Neapolitan writers of the day. About the same time he wrote his first work on political economy, entitled *Della Moneta*, the leading principle of which is that coin is a merchandise, and that its value and interest ought to be left free, as in other goods. His appointment as secretary of legation at Paris in 1759 brought him into contact with the Encyclopædists and the economic writers of that capital. Five years later he published *Dialoghi sul Commercio del Grano* ('Dialogues upon the Trade in Corn'), in which he argues against both the extreme protectionists and the pure free-traders. After his recall to Naples in

1769 he became successively councillor of the tribunal of commerce and (1777) minister of the royal domains. He died at Naples, 30th October 1787. See his *Correspondance* with Mdme. D'Epinay, Holbach, Grimm, Diderot, &c. (1818; new ed. 1881).

Galicia, formerly a kingdom and afterwards a province in the north-west of Spain, bounded N. and W. by the Atlantic, S. by Portugal, and E. by Leon and Asturias, with an area of 11,340 sq. m., has been divided since 1833 into the minor provinces of Coruña, Lugo, Orense, and Pontevedra, whose joint population in 1886 was 1,919,846. The country is mountainous, being traversed by offsets of the Asturian chain, rising in their highest peaks to about 6500 feet. The westernmost spurs, Capes Ortegal and Finisterre, project into the Atlantic. The numerous short but rapid rivers form small estuaries which afford secure havens and roads. The principal river is the Minho, which, with its feeder the Sil, is navigable for small vessels on its lower course. Galicia is one of the most fruitful portions of Europe, and has a mild, nourishing climate; but agriculture is in a backward condition, capital is scarce, roads are bad, and railways are few. Rich meadows and dense forests occur everywhere, but the soil is more suited to the cultivation of garden-produce than of corn. Mines of lead, tin, copper, and iron pyrites are worked. The inhabitants, called Gallegos, are a robust, vigorous, industrious race. Great numbers of them annually visit central and southern Spain and Portugal, where they find employment as harvesters, water-carriers, porters, &c. Chief exports, live cattle, preserved meat, eggs, minerals, fish, fruits, and grain; imports, coal, oil, hides, spirits, sugar, and tobacco. The principal towns are Santiago di Compostella and the two strongly fortified seaports Coruña and Ferrol. Galicia was a kingdom, under the Suevi from 411 to 585, and again from 1060 to 1071, at which date it was finally incorporated with Leon and Castile.

Galicia (Polish *Halicz*), a crown-land belonging to the Austrian monarchy, including the former kingdoms of Galicia and Lodomeria, the duchies of Auschwitz and Zator, and the grand-duchy of Cracow, lies between the Carpathians on the S. and Russian Poland on the N., and between Silesia on the W. and Russia on the E. Area, 30,300 sq. m.; pop. (1888) 6,370,837. With the exception of 100,000 Germans and 686,600 Jews, the inhabitants are of Slavonic race, the western part of Galicia being occupied mainly by Poles, the eastern by Ruthenians. In religion about 2½ millions, mostly Ruthenians, belong to the Greek Church, and nearly 2¾ millions, chiefly Poles, to the Roman Catholic Church. The southern portion of the country is a high terrace, flanking the northern face of the Carpathians. Thence the land slopes away northwards, through a low hilly region, to the deep plains of the Dniester and the Vistula. There are many large rivers—those in the west being feeders of the Vistula, those in the east of the Danube and Dniester. The climate of Galicia is colder than that of any other portion of the Austrian empire, as it is freely exposed to the north and north-east winds. Yearly mean of temperature at Lemberg, 46·4° F.; mean of July, 66·9°; of January, 25·2°; annual rainfall, about 28 inches. The soil is for the most part fertile, and produces oats, rye, and barley in sufficient quantity for export. Wheat, flax, hemp, tobacco, and oil plants are likewise cultivated. Fruit-growing and market-gardening are prosecuted, also bee-keeping. Horses, cattle, and sheep are raised in considerable numbers. Wolves and bears are still found in the mountainous districts. One-fourth of the surface is covered with forests, which yield large quantities of timber for export. Salt is the most important mineral. But coal, iron ore, sulphur, lead, zinc, and petroleum are also extracted. The annual product of the petroleum springs is about 90,000 tons. There are about thirty-five mineral springs, most of them containing sulphur. The industries are few, and, except the manufacture of cloth and the distilling of brandy and of petroleum, not important. Trade, however, chiefly in the hands of the Jews, is pretty active. Lemberg and Cracow, the principal towns, have each a university; the former is the capital of the crown-land. Galicia is ruled by an Austrian governor and an independent diet; to the imperial diet it sends sixty-three members. Galicia takes its name from the old fortress and town of Halicz, on the Dniester. The original Slavonic inhabitants, the Ruthenes, were in the 9th century conquered by the Russians of Kieff. The western portion of the country was dependent on Poland, and afterwards on Hungary. In 1382 it was definitely restored to Poland, and continued to belong to that country till the partition of 1772, when Galicia became one of the crown-lands of Austria. In 1846 Cracow, with the territory belonging to it, was given up to the emperor of Austria, and by him (1849) annexed to the crown-land of Galicia.

Galicz. See HALICZ.

Galignani, JOHN ANTHONY and WILLIAM, Parisian publishers, were born in London, the former 13th October 1796, the latter 10th March 1798. Their father, an Italian, founded an English library at Paris in 1800, and there published an English *Monthly Repertory*, and in 1814 the famous newspaper, *Galignani's Messenger*. The *Messenger* was much improved by his sons, who made it an important medium for advocating cordiality between England and France. The brothers founded at Corbeil near Paris a hospital for distressed Englishmen; and in 1889 the Galignani Home for decayed members of the printing and bookselling trades was opened at Neuilly. The elder brother died 30th December 1873, and the younger 12th December 1882.

Galilee (Heb. *Galil*, a 'circle' or 'circuit'), a name latterly applied to one of the four Roman divisions of Palestine, originally referred only to a district of the tribe of Naphtali. In the time of our Lord, Galilee embraced the whole northern portion of Palestine from the Mediterranean to the Jordan. The district was divided into Upper and Lower Galilee, the former being hilly and well wooded, the latter level and very fertile. At that time it was mainly inhabited by Syrians, Phœnicians, Arabs, and Greeks, with a few Jews. The principal towns were Tiberias and Sepphoris; those that figure in the gospels are Cana, Capernaum, Nazareth, and Nain. The Jewish inhabitants were held in low estimation by their brethren in Judæa, on account of their less rigid sentiments in regard to religion. After the destruction of Jerusalem the despised Galilee became the refuge of the proud doctors of Jewish law, and the city of Tiberias the seat of Rabbinical learning. The ruins of many fine synagogues are still extant in this region. Galilee now forms part of the pashalic of Damascus, in the Turkish province of Syria, and, as of yore, is remarkable for its beauty and fertility. It still has a considerable number of Jewish inhabitants. See Dr S. Merrill, *Galilee in the Time of Christ* (new ed. 1885).

The SEA OF GALILEE, called also in the New Testament the *Lake of Gennesaret* and the *Sea of Tiberias*, and in the Old Testament the *Sea of Chinnereth* or *Cinneroth*, a large lake in the northern half of Palestine. Lying 626 feet above sea-level,

it is 13 miles long by 6 broad, and 820 feet deep. It occupies the bottom of a great basin, and is undoubtedly of volcanic origin. Although the Jordan runs into it red and turbid from the north, and many warm and brackish springs also find their way thither, its waters are cool, clear, and sweet. Its shores on the east and north sides are bare and rocky; on the west sloping gradually, and luxuriantly covered with vegetation. The surrounding scenery is hardly beautiful, but its associations are the most sacred in the world. It is enough to mention the names of some of the towns on its shores, Bethsaida, Capernaum, Magdala, and Tiberias. In the time of Jesus the region round about was the most densely populated in Galilee; now even its fisheries are almost entirely neglected.

Galilee, the name applied to a porch or chapel attached to a church, in which penitents stood, processions were formed, and corpses deposited for a time previous to interment. In some religious houses the galilee was the only part of the church accessible to women; the monks came to the galilee to see their female relatives—the women being told in the words of Scripture, 'He goeth before you into Galilee; there shall you see him' (Matt. xxviii. 7). A portion of the nave was sometimes marked off by a step, or, as at Durham, by a line of blue marble, to mark the boundary to which women were limited. There are galilees in the cathedrals of Lincoln (on west side of south transept), Ely (at west end of nave), and Durham (west end of nave).

Galile'i, GALILE'O, one of the fathers of experimental science, was born at Pisa on the 18th of February 1564. By the desire of his father, the descendant of an ancient Florentine family, Galileo directed his early studies to medicine, and of course the prevailing Aristotelian philosophy; but the dogmas of this last he soon ventured to disbelieve and despise. Entering the university of Pisa in 1581, he made there two years later one of his most important discoveries. Happening to observe the oscillations of a bronze lamp in the cathedral of Pisa, he was struck with the fact that the oscillations, no matter what their range, seemed to be accomplished in equal times. The correctness of this observation he at once proceeded to test, and then, comparing the beat of his own pulse with the action of the pendulum, he concluded that by means of this equality of oscillation the simple pendulum might be made an invaluable agent in the exact measurement of time, a discovery which he utilised some fifty years later in the construction of an astronomical clock. About this time his irrepressible bias towards mechanical constructions and experimental science received a new impulse from his introduction to the principles of mathematics. The first fruit of his ardent pursuits of the new studies was the invention of a hydrostatic balance and the composition of a treatise on the specific gravity of solid bodies. These achievements secured him the appointment of professor of Mathematics in the university of Pisa, where he propounded the novel theorem, that all falling bodies, great or small, descend with equal velocity, and proved its correctness by several experiments made from the summit of the leaning tower of Pisa. This provoked the enmity of the Aristotelians, whose bitterness was exacerbated by the cutting sarcasms of the successful demonstrator. Nevertheless Galileo in 1591 deemed it prudent to resign his chair at Pisa, and retire to Florence, though another cause has been assigned for his resignation—viz. that he ridiculed the mechanical pretensions of Giovanni de' Medici, son of Cosmo I.

In the following year he was nominated to the chair of Mathematics in the university of Padua, where his lectures attracted crowds of pupils from all parts of Europe. Here he taught and worked for eighteen years, from 1592 to 1610. It may be remarked parenthetically that he was the first to adapt the Italian idiom to philosophical instruction. Among the various discoveries with which he enriched science may be noticed a species of thermometer, a proportional compass or sector, and, more important than all, the refracting telescope for astronomical investigation. This last, however, he seems not to have invented entirely independently: an account of an instrument for enlarging distant objects, invented by a Dutchman, seems to have reached him whilst on a visit to Venice in May 1609; thereupon setting his inventive wits to work, he constructed an apparatus involving the principles of the telescope. Rapidly improving the construction of his original instrument, Galileo now began a series of astronomical investigations, all of which tended to convince him still more of the correctness of the Copernican heliocentric theory of the heavens, of the truth of which he seems indeed to have been early persuaded. He concluded that the moon, instead of being a self-luminous and perfectly smooth sphere, owed her illumination to reflection, and that she presented an unequal surface, diversified by valleys and mountains. The Milky-way he pronounced a track of countless separate stars. Still more important, however, was the series of observations which led to the discovery of the four satellites of Jupiter on the night of the 7th of January 1610 (though it was not till the 13th of the same month that he came to the conclusion that they were satellites, and not fixed stars), which he named the Medicean stars, in honour of his protectors, the Medici family. He also first noticed movable spots on the disc of the sun, from which he inferred the rotation of that orb. In this year he was recalled to Florence by the Grand-duke of Tuscany, who nominated him his philosopher and mathematician extraordinary, gave him a good salary, and exacted from him no duties save those of prosecuting his scientific investigations untrammelled. At Florence, continuing his astronomical observations, he discovered the triple form of Saturn and the phases of Venus and of Mars.

In 1611 Galileo visited Rome and was received with great distinction, being enrolled a member of the Lincei Academy. Yet the publication, two years later, of his *Dissertation on the Solar Spots*, in which he openly and boldly professed his adhesion to the Copernican view, provoked against him the censure and warning of the ecclesiastical authorities. But this he partly brought upon himself by his aggressive attitude towards the champions of orthodoxy and even towards the Scriptures, whose astronomical system he hesitated not to challenge. Galileo, however, promised (26th February 1616) to obey Pope Paul V.'s injunction, thenceforward not to 'hold, teach, or defend' the condemned doctrines. After that he seems to have been again taken into favour by the pope and other high dignitaries of the church; indeed personally he seems never to have lost their esteem. But in 1632, ignoring his pledge, he published the *Dialogo sopra i due massimi Sistemi del Mondo*, a work written in the form of a dialogue between three fictitious interlocutors, the one in favour of the Copernican system, the second an advocate of the Ptolemaic, and the third a well-meaning but stupid supporter of the Aristotelian school. Hardly had the work been issued when it was given over to the jurisdiction of the Inquisition. Pope Urban VIII., previously Cardinal Barberini, a friend and admirer of Galileo, was led to believe that Galileo had satirised him in this work in the person of the third inter-

locutor, as one who was careless about scientific truth, and who timidly adhered to the rigid traditions of antiquity. In spite of his seventy years and heavy infirmities Galileo was summoned before the Inquisition, and, after a wearisome trial and incarceration, was condemned to abjure by oath on his knees the truths of his scientific creed. Since the year 1789 a legend has been current to the effect that on concluding his recantation he exclaimed, *sotto voce*, 'E pur si muove' (Nevertheless it does move). The question whether he was put to the torture or no has given rise to a keen controversy, in which neither side can justly claim to have offered evidence that is finally conclusive. He was certainly subjected to the *examen rigorosum*, the last stage of which is actual torture. But the official accounts of the trial make no mention of this last stage having been reached. On the other hand, it has been asserted that the records of his trial have been tampered with. Galileo was further sentenced to an indefinite term of imprisonment in the dungeons of the Inquisition; but this was commuted by Pope Urban, at the request of Ferdinand, Duke of Tuscany, into permission to reside at Siena, and finally at Florence. In his retreat at Arcetri, near Florence, he continued with unflagging ardour his learned researches, even when hearing grew enfeebled and sight was extinguished. Just before he became totally blind, in 1637, he made yet another astronomical discovery, that of the moon's monthly and annual librations. He died on the 8th of January 1642, and was interred in the church of Santa Croce, the pantheon of Florence. His disposition was genial; he enjoyed the social wit and banter of his chosen friends; and the readiness with which he offered or accepted atonement modified a somewhat irascible disposition. The great deficiencies in his character were a want of tact to keep out of difficulties, and a want of moral courage to defend himself when involved in them. His biting satirical tongue, more than his physical discoveries, was the cause of his misfortunes. He loved art, and cultivated especially music and poetry. Ariosto he knew almost by heart, and appreciated keenly the beauties of this classic. Tasso, on the other hand, he unduly depreciated, and severely criticised him in *Considerazioni al Tasso*. His own style is nervous, flowing, and elegant. In addition to the discoveries and inventions already recorded we owe to the genius of Galileo the formulation of the law of uniformly accelerated motion in the case of bodies falling freely towards the earth, the determination of the parabolic path of projectiles, the theory of virtual velocities, and the law that all bodies, even invisible ones like air, have weight. The best edition of Galileo's collected works is that by Alberi (16 vols. Flor. 1842–56).

See Viviani's *Life of Galileo* (1654); Henri Martin's *Galilée* (1868); H. de l'Épinois in *Revue des Questions Historiques* (1867), and *Les Pièces du Procès de Galilée* (1877); Gebler, *Galileo und die Römische Curie* (1876); Berti, *Copernico e Sistema Copernicano*, and *Il Processo Originale di Galileo* (1876); Wohlwill, *Ist Galilei gefoltert worden?* (1877); Favaro, *Galileo Galilei* (2 vols. Flor. 1882); Wegg-Prosser, *Galileo and his Judges* (1889).

Galingale, a name often applied to the tubers of *Cyperus longus*, and sometimes to the whole plant. The tubers are of ancient medicinal repute, and are sometimes still eaten as a vegetable in Greece. See CYPERUS.

Galion, a town of Crawford county, Ohio, at the junction of several railways, 58 miles N. by E. of Columbus, with several cigar-factories and machine-shops, two railroad-shops, and a foundry. Pop. 5635.

Galipea. See ANGOSTURA BARK.

Galitzin, also GALLITZIN, GALYZIN, or GOLYZIN, one of the most powerful and distinguished Russian families, whose members, too numerous to catalogue, have been equally prominent in war and diplomacy from the 16th century downwards.—VASILI, surnamed the Great, born in 1643, was the councillor and favourite of Sophia, the sister of Peter the Great, and regent during his minority. His great aim was to bring Russia into contact with the west of Europe, and to encourage the arts and sciences in Russia. His design to marry Sophia, and plant himself on the Russian throne, miscarried. Sophia was placed by her brother in a convent, and Vasili banished (1689) to a spot on the Frozen Ocean, where in 1714 he died.—DIMITRI (1735—1803), Russian ambassador to France and Holland and intimate friend of Voltaire and Diderot, and the Encyclopædists, owes the preservation of his name mainly to his wife, the celebrated AMALIE, PRINCESS GALITZIN (1746–1806), daughter of the Prussian general, Count von Schmettau. She was remarkable for her literary culture, her grace and amiability of disposition, her sympathetic relations with scholars and poets, but, above all, for her ardent piety, which found in Catholicism its most congenial sphere. Having separated from her husband, she took up her residence in Münster, where she gathered round her a circle of learned companions, including for a longer or shorter time Jacobi, Hemsterhuis, Hamann, and Count Stolberg.—DIMITRI AUGUSTINE, son of the foregoing, was born at the Hague, December 22, 1770. He became a Roman Catholic in his seventeenth year; and, through the influence exercised over him by a clerical tutor during a voyage to America, he resolved to devote himself to the priesthood. In 1795 he was ordained a priest in the United States by Bishop Carroll of Baltimore, and betook himself to a bleak region among the Alleghany Mountains, in Pennsylvania, where he was known as 'Father Smith' (Smith being originally a corruption of Schmettau). Here he laid the foundation of a town, called Loretto, where he died 6th May 1840. He declined to return to Russia on his father's death, and as a Catholic priest was adjudged to have lost his right of inheritance. He was for some years vicar-general of the diocese of Philadelphia. He was austere in his mode of life, but liberal in the highest degree to others, and an affectionate and indefatigable pastor. He wrote various controversial works, including a *Defence of Catholic Principles* (1816), *Letter to a Protestant Friend* (1820), and *Appeal to the Protestant Public* (1834). See the Lives by Heyden and by Brownson.

Galium. See BEDSTRAW.

Gall. A synonym for Bile (q.v.), the secretion of the Liver (q.v.). See also GALLS.

Gall, FRANZ JOSEPH, the founder of phrenology, was born at Tiefenbronn, near Pforzheim, on the borders of Baden and Würtemberg, 9th March 1758. He studied medicine at Strasburg and Vienna, and settled in the latter city in 1785 as a physician. From his boyhood he had been attracted by the problems arising out of the relations between the powers of mind, the functions of the brain, and the external characters of the cranium. In 1796 he began to give courses of lectures on Phrenology (q.v.) in Vienna; but the lectures were prohibited in 1802 by the Austrian government as being subversive of the accepted religion. Along with Spurzheim (q.v.), who became his associate in 1804, Gall quitted Vienna in 1805, and began a lecturing tour through Germany, Holland, Sweden, and Switzerland. He reached the height of his fame when in 1807 he settled as a physician in Paris. On 14th March 1808 he and

Spurzheim presented to the Institute of France a memoir of their discoveries, on which a committee of the members of that body (including Pinel, Portal, and Cuvier) drew up an unfavourable *Report*. Thereupon Gall and Spurzheim published their memoir, *Introduction au Cours de Physiologie du Cerveau;* this was subsequently followed by *Recherches sur le Système Nerveux* (1809), and by *Anatomie et Physiologie du Système Nerveux* (4 vols. 1810–19), with an atlas of 100 plates. But, the two phrenologists having parted in 1813, the name of Gall alone is prefixed to vols. 3 and 4; and it alone is borne by a reprint of the physiological portion of the work, entitled *Sur les Fonctions du Cerveau, et sur celles de chacune de ses Parties* (6 vols. 1825). In 1811, in answer to accusations of materialism and fatalism brought against his system, Gall published *Des Dispositions Innées de l'Âme et de l'Esprit.* He continued to practise medicine and pursue his researches at Montrouge, near Paris, till his death, 22d August 1828.

Gall, ST. See ST GALL.

Gallait, LOUIS, a Belgian historical painter, was born at Tournay in 1812, and has become famous by pictures on subjects from the history of the Low Countries, such as 'The Abdication of Charles V.' (1841), 'Alva viewing the dead bodies of Egmont and Horn' (1851), and 'The Plague of Tournay' (1882), which last the Brussels Museum purchased for £4800. He is a member of many academies at home and abroad.

Galland, ANTOINE, a French orientalist and archæologist, was born 4th April 1646, at Rollot, near Montdidier, in Picardy. Attached in 1670 to the French embassy at Constantinople, he three years later accompanied the ambassador De Nointel to Syria and the Levant. In 1676, and again in 1679, he made other visits to the East, where he gathered valuable collections of antiquities, and acquired a good knowledge of oriental languages. In 1701 he was made a member of the Académie des Inscriptions, and in 1709 professor of Arabic in the Collége de France. He died at Paris, 19th February 1715. The greatest part of Galland's writings relate to archæological subjects, especially to the numismatics of the East; but the work which has secured him the greatest reputation is his translation of the *Arabian Nights* in 12 vols. (*Les Mille et Une Nuits*, Paris, 1704–8), the first translation of these stories made into any language of Christendom (see ARABIAN NIGHTS). Among his other writings we may mention *Paroles Remarquables, Bons Mots, et Maximes des Orientaux* (1694), and *Les Contes et Fables Indiennes de Bidpaï et de Lokman* (2 vols. 1724). See also *Journal d'Antoine Galland pendant son séjour à Constantinople, 1672–73*, edited by Ch. Schefer (2 vols. 1881).

Galla Ox, or SANGA, a remarkable species or variety of ox inhabiting Abyssinia. The chief peculiarity is the extraordinary size of the horns, which rise from the forehead with an outward and then an inward curve, producing a very perfect figure of a lyre, and finally curve a little outwards at the tip, to which they taper gradually.

Gallas, a race of people inhabiting that part of Africa which lies to the south and west of Harar and south of Shoa, between 9° and 3° S. lat. and 34° and 44° E. long. Their racial affinities are not yet conclusively settled; the best authorities regard them as belonging to the Ethiopic branch of the Hamites, and their language as a descendant of the ancient Geez of Abyssinia. Individually they are of average stature, with strong, well-made limbs, skin of a light chocolate brown, hair frizzled but not woolly. Though cruel in war, they are of frank disposition, and faithfully keep their promises and obligations. They are distinguished for their energy, both physical and mental, especially those tribes, to the south and south-west, which pursue pastoral avocations, notably the breeding of horses, asses, sheep, cattle, and camels, and those which live by hunting, especially the elephant. These same tribes are mostly still heathens, though Mohammedanism is rapidly making way amongst them. The more northerly tribes who dwell about Harar profess a crass form of Christianity, derived from Abyssinia, and for the most part practise agriculture, raising cotton, durra, sugar, and coffee. The total Galla population, who call themselves Argatta or Oromo, is approximatively estimated by Reclus at 3½ millions; the northern tribes are put by Paulitschke at 1¼ million. Politically they are divided into a great number of separate tribes (Itu, Arussi, Nole, Jarsso, Ala, Ennia, Walamo, Borana, &c.), which are frequently at war with one another. But their inveterate century-long foes are the Somali on the north-east and east, who have gradually driven back the Gallas from the shores of the Red Sea and the extremities of the Somali peninsula, regions which were occupied by them in the 16th century, just as on the other side the Abyssinians and Shoans have beaten them back southwards. The country they now inhabit is, generally speaking, a plateau that slopes south-eastward to the Indian Ocean, and has a hilly, well-timbered surface. On the north, from Harar to the Hawash, stretches the watershed dividing the rivers that flow to the Red Sea and Gulf of Aden from those that drain south-eastwards to the Indian Ocean, and culminating in two limestone massifs (7250 feet), called Concuda and Gara Mulata. The watershed separating the rivers Webi (with its tributary the Erer) and Wabi (also called Juba), which flow south-east to the Indian Ocean, from the feeders of the Upper Nile region, skirts the western side of the Galla territory. This region, with plenty of rains and running streams, a rolling surface diversified with hill-chains, and abundant vegetation, is well cultivated, and yields wheat, barley, beans, sorghum, sweet potatoes, flax, lentils, cotton, and coffee. Its average elevation is 7200 feet. Amongst all the western tribes inhabiting this region slavery is a recognised institution. See Paulitschke, *Ethnographie und Anthropologie der Somal, Galla, und Harari* (Leip. 1886), and in *Globus*, 1889, and Cecchi, *Fra Zeila alle Frontiere del Caffa* (2 vols. Rome, 1885).

Gallatin, ALBERT, financier and statesman, was born at Geneva in 1761, and graduated at the university there in 1779. In 1780 he went to the United States, where he engaged in trade, and was for a time teacher of French in Harvard College. Afterwards he purchased land in Virginia and Pennsylvania, and made his entrance into political life in the latter state in 1789. In 1793 he was elected to the United States senate, and in 1795 entered congress. In 1801–13 he was Secretary of the Treasury, in which post he was of signal service to his adopted country, and showed himself one of the first financiers of his day. He took an important part in the negotiations for peace with England in 1814, and signed the treaty of Ghent. From 1815 to 1823 he was minister at Paris, and in 1826 he was sent to London as ambassador-extraordinary. On his return in 1827 he settled in New York, and devoted much of his time to literature, being chiefly occupied in historical and ethnological researches. He was one of the founders and the first president of the Ethnological Society of America; and from 1843 to his death he was president of the New York Historical Society. He died August 12, 1849. His works include publications on finance, politics, and ethnology; among these last are *The Indian Tribes*

east of the Rocky Mountains, &c. (1836), and *Notes on the Semi-civilised Nations of Mexico, Yucatan, and Central America* (1845). See the Lives by Henry Adams (1879) and J. A. Stevens (in the '*American Statesman*' series, 1883).

Gallaudet. See DEAF AND DUMB.

Gall-bladder. See LIVER.

Galle, or POINT DE GALLE, a fortified town and seaport of the south-west extremity of the island of Ceylon, stands on a low rocky promontory of the same name, and has a good harbour, formed by a small bay. It has lost its former importance as a coaling and transhipping station for the great lines of steamers from Europe to Australia and China since the completion of the breakwater at Colombo (q.v.). It is the capital of the southern province of Ceylon. Pop. (1881) 31,743. See CEYLON.

Galle'go, one of the principal affluents of the Ebro (q.v.).

Galleon (Spanish), a large ship formerly used by the Spaniards to carry home the gold, silver, and other wealth contributed by the Mexican and South American colonies. They were armed, and had usually three or four decks, with bulwarks three or four feet thick, and stem and stern built up high like castles. They had a particular fascination for Drake and other Elizabethan rovers, who so contrived that many of them never reached the ports of Spain.

Gallery, a word with several applications in architecture. A long passage or corridor is called a gallery. A long room, such as is frequently used for exhibiting pictures; a raised floor in any apartment, supported on pillars; a long passage in the thickness of the wall, or supported on cantilevers (as the Whispering Gallery of St Paul's)—all these are called galleries. They were of very frequent use in the buildings of the middle ages. The Roodloft (q.v.) is a gallery running across a church at the entrance to the choir, and supporting a large cross. Organ galleries are also frequent, either in the position of the roodloft, or at one end of the nave or transept, or corbelled out from the side-wall. In old baronial halls the end next the door was usually screened off as an entrance passage, and above the screen was almost invariably a gallery for musicians. In Scottish castles such a gallery was frequently constructed in the thickness of the wall. In the older German and French churches the side-aisles were divided into two stories—the upper forming a gallery said to be for the exclusive use of the women. The arrangement of galleries in tiers one over the other, now so much used in churches, theatres, &c., is entirely modern, dating from the 17th century. For galleries in the military and mining connection, see MINES.

Galley, a long, narrow row-boat, carrying a sail or two, but dependent for safety and movement mainly upon oars. These boats were called galleys, galleots, and brigantines (or frigates) according to their size: a galleot is a small galley, while a brigantine is still smaller. The number of men to each oar varied according to the vessel's size: a galley had four to six men working side by side to each oar, a galleot but two or three, and a brigantine one. A galley was 180 or 190 spans (of 9 to 10 inches) long, and its greatest beam was 25 spans broad. Such a vessel carried two masts—the *albero maestro* or mainmast, and the *trinchetto* or foremast, each with a great lateen sail. The Genoese and Venetians set the models of these vessels, and the Italian terms were generally used in all European navigation till the northern nations took the lead in sailing ships. These sails were often clewed up, however, for the mariner of the 16th century was ill-practised in the art of tacking, and very fearful of losing sight of land for long, so that unless he had a wind fair astern he preferred to trust to his oars. A short deck at the prow and poop served, the one to carry the fighting men and trumpeters and yardsmen, and to provide cover for the four guns; the other to accommodate the knights and gentlemen, and especially the admiral or captain. Between the two decks, in the ship's waist, was the propelling power—say fifty-four benches or banks, twenty-seven a side, supporting each four or five slaves, whose whole business in life was to tug at the fifty-four oars. If a Christian vessel, the rowers were either Turkish or Moorish captives, or Christian convicts; if a Barbary corsair, the rowers would all be Christian prisoners.

Sometimes a galley-slave worked as long as twenty years, sometimes for all his miserable life, at this fearful calling. The poor creatures were chained so close together on their narrow bench that they could not sleep at full length. Sometimes seven men (on French galleys, too, in the 18th century) had to live and sleep in a space 10 feet by 4. Between the two lines of rowers ran the bridge, and on it stood two boatswains armed with long whips, which they laid on to the bare backs of the rowers with merciless severity. Biscuit was made to last six or eight months, each slave getting 28 ounces thrice a week, and a spoonful of some mess of rice or bones or green stuff. The water-cans under the benches were too often foul. The full complement of a large galley included, besides 270 rowers and the captain, chaplain, doctor, scrivener, boatswains, and master or pilot, ten or fifteen gentlemen adventurers, friends of the captain, sharing his mess, and berthed in the poop, twelve helmsmen, six foretop able-bodied seamen, ten warders for the captives, twelve ordinary seamen, four gunners, a carpenter, smith, cooper, and a couple of cooks, together with fifty or sixty soldiers, so that the whole equipage of a fighting galley must have reached a total of about four hundred men.

What is true of a European galley is also generally applicable to a Barbary galleot of eighteen to twenty-four oars, except that the latter was generally smaller and lighter, and had commonly but one mast and no castle on the prow. The crew of about two hundred men was very densely packed, and about one hundred soldiers armed with muskets, bows, and scimitars occupied the poop. The rowers on Barbary galleys were generally Christian slaves belonging to the owners, but when these were not numerous enough other slaves, or Arabs and Moors, were hired. The complement of soldiers, whether volunteers or Ottoman janissaries, varied with the vessel's size, but generally was calculated at two to each oar, because there was just room for two men to sit beside each bank of rowers. They were not paid unless they took a prize, nor were they supplied with anything more than biscuit, vinegar, and oil—everything else they found themselves. Vinegar and water with a few drops of oil on the surface formed the chief drink of the galley-slaves, and their food was moistened biscuit or rusk and an occasional mess of gruel.

A galleass was originally a large, heavy galley, three-masted, and fitted with a rudder, since its bulk compelled it to trust to sails as well as oars. It was a sort of transition-ship between the galley and the *galleon*, and as time went on it became more and more of a sailing ship. It had high bulwarks with loopholes for muskets, and there was at least a partial cover for the crew. The Portuguese galleys in the Spanish Armada mounted each 110 soldiers and 222 galley-slaves; but the Neapolitan galleasses carried 700 men, of whom 130 were sailors, 270 soldiers, and 300 slaves of the

oar. In France the convict galleys were gradually superseded from 1748 by the Bagnes (q.v.). John Knox laboured for eighteen months at the oar, and St Vincent de Paul (q.v.) did much for the galley-slaves. See also TRIREME, SHIPBUILDING.

Furttenbach, *Architectura Navalis;* S. Lane-Poole, *The Barbary Corsairs* ('Story of the Nations'); and M. Oppenheim, in *Gentleman's Magazine* (1885).

Gall-fly, or GALL-WASP, [illegible] lied to any member of a large [illegible] of Hymenopterous insects, most of the females of which lay their eggs in plants and by the associated irritation produce galls. The insects are not unlike little wasps, with straight, thread-like antennæ, laterally compressed abdomen, and long wings. The eggs are laid in the leaves, twigs, roots, &c. of plants, which the mothers pierce with their ovipositors. The irritation of the wound and of the intruded and rapidly developing eggs results in pathological excrescences or galls. Within these the larvæ feed and grow, and either eat their way out while still grubs or remain till the pupa stage is past and emerge as adolescent insects. A gall may contain a single egg and larva or many, and both external form and internal structure vary widely.

Fig. 1.—Bedeguar Gall of Wild Rose.

Each gall-fly has its favourite or exclusive host, and usually restricts its egg-laying to some special part of the plant. While most produce true galls, some members of the family act like cuckoos and utilise galls already formed by other genera. Others again depart more widely from the general habit and deposit their ova in other insects. The genera Cynips, Aphilotrix, Andricus, Neuroterus, Spathegaster, Biorhiza all form galls on oaks; Rhodites is the cause of mossy excrescences on rose bushes. Among those which utilise already formed galls Synergus and Aulax are important genera; while Ibalia, Figites, Eucoila, and the minute species of Allotria are in their youth parasitic on other insects such as flies and plant-lice.

The reproductive relations of gall-flies are very interesting: in many cases parthenogenesis undoubtedly occurs; in some species—e.g. of Rhodites, no males have ever been found; in other forms the

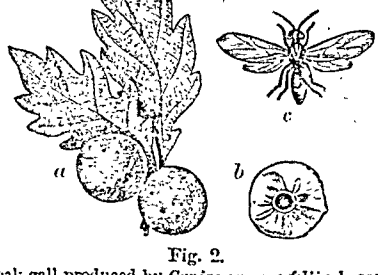


Fig. 2.

a, oak gall produced by *Cynips quercus-folii;* *b*, section of gall; *c*, gall-insect (*Cynips quercus-folii*).

males when they occur are very few in proportion to the females. It must be emphasised that many gall-wasps distinguished by entomologists as separate species or even referred to different genera have turned out to be the parthenogenetic and the sexual forms of one species. A common life-history is as follows: (*a*) Out of a summer-gall male and female forms emerge; (*b*) the females lay their fertilised eggs and give origin to winter-galls in so doing; (*c*) from these winter-galls there arise parthenogenetic females which in their egg-laying produce the summer-galls from which we started.

Among the common gall-wasps *Cynips quercus-folii* makes the cherry-galls of oak leaves; *C. tinctoria* produces the well-known ink-gall of the Levantine oak; *Rhodites rosæ* forms the curious and familiar 'Bedeguar' (q.v.) excrescence on wild roses.

See GALLS, INK, INSECT, PARTHENOGENESIS. For the life-histories, see Adler, *Zeitsch. f. wiss. Zoologie,* xxxv. (1881); *Annals and Magazine of Natural History* (5th series, vol. viii.); Bassett, *Canad. Entomologist* (1873-75, p. 91); W. K. Brooks, *Heredity* (Baltimore, 1883).

Galliard, the name of a lively dance, the same, according to Brossard, as the *Romanesca,* a favourite dance with the Italians. The air is mostly in $\frac{6}{8}$ or $\frac{3}{4}$ time, but sometimes also in $\frac{2}{4}$ or $\frac{4}{4}$ time. The tempo is also quick and lively, with a flowing melody. Many galliard tunes are still extant, distinguished by such names as *The King of Denmark's Galliard, The Earl of Essex's Galliard,* and the like. The word is due to the Spanish *gallarda,* of dubious origin; Diez refuses to connect it with *gala* and *gallant* (Span. *galante*) on account of the double *l* and the French form *gaillard,* itself most likely of Celtic origin.

Gallic Acid, $HC_7H_5O_5,H_2O$, is an acid which exists in small quantity in gall-nuts, in valonia (the acorn-cup of *Quercus ægilops*), in divi-divi (the pod of *Cæsalpinia coriaria*), in sumach, and other vegetables. It is usually prepared from gall-nuts, which, in addition to gallic acid, contain a large proportion of tannin (tannic acid or gallo-tannic acid). When the gall-nuts are digested with water for some weeks fermentation takes place, and the tannic acid is gradually converted into gallic acid. The same result is obtained more quickly if sulphuric acid be present. To obtain pure gallic acid the gall-nuts are boiled with water, and the hot liquor separated. On cooling gallic acid crystallises out, and is further purified by solution in hot water and treatment with animal charcoal.

It forms delicate, silky, acicular crystals, nearly colourless, and having a sourish taste. It is soluble in 3 parts of boiling water, but only in 100 of cold water, and on this account it can be readily purified by recrystallisation. With solution of iron salts (ferric) it produces a blue-black colour, and finally yields a black precipitate on exposure to the air. Hence it may be used in the production of ink, for which purpose it has some advantages over tannin or gall-nuts. When the crystals are strongly heated pyrogallic acid is produced and sublimes over. Gallic acid is a useful astringent. As it does not coagulate albumen it is readily absorbed into the blood, and in this way it is efficacious in Bright's disease. Where a decided local astringent effect is desired tannic acid is much more powerful.

Gallican Church, the designation applied to the Catholic Church in France, in respect of the more or less independent attitude which it formerly occupied toward the Roman see.

Flourishing Christian communities already existed at Lyons and Vienne at the time of the persecution under Marcus Aurelius, when the aged bishop Pothinus was martyred (177). The origin of these churches is traced principally to Asia Minor, where Irenæus (q.v.) was born, and they were in intimate connection with Smyrna and other churches of the East. The historian Gregory

of Tours (6th century) speaks of seven missionary bishops sent to Gaul from Rome, of whom Saturninus settled at Toulouse, Dionysius at Paris, and Trophimus at Arles. Probably his account is a combination of various local traditions of the first bishops of important towns with a much earlier narrative of the martyrdom of Saturninus under Decius (250). Although sharing in the general literary inferiority of Western ecclesiastics during the early period, the church of Gaul numbers several eminent names in the literature of the 3d, 4th, and 5th centuries. The works of Irenæus, Sulpicius Severus, Hilary of Poitiers, Hilary of Arles, Vincent of Lerins, Prosper, Victor, Eucherius, Salvian, and Gregory of Tours combine to form a body of literature of which the later French Church is not unreasonably proud. The hierarchical organisation of the church in Gaul was from an early period among the most complete and regular in western Christendom; and in the council held at Arles in 314 we may recognise the titles of many bishops of sees which are still represented in the episcopate of France.

But the history of the Gallican Church, so far as regards the development of those peculiar principles which have acquired the distinctive name of 'Gallicanism,' begins at a much later period. From circumstances which are differently viewed by the opposite schools of theology, the papacy began, from the very date of the establishment of the Western Empire, to exercise a large influence over the civil as well as ecclesiastical affairs of the several European kingdoms. On the other hand, owing to the intimate connection between the church and state in most of these kingdoms, and especially to the feudal relations between the crown and the church dignitaries, the crown also asserted a correlative claim to certain privileges in respect of ecclesiastical affairs. The satisfactory adjustment of these conflicting claims was the great problem of medieval polity; and the alternations of the struggle between them form the staple of medieval history. In the church of France the party maintaining the prerogatives of the French crown and the privileges of the national church of France against the adverse claims of the Roman see gave to the principles which they professed the name of Gallicanism. This name has come to designate, in general, that system in Roman Catholic theology which, while it recognises the primacy of the Roman pontiff, by divine right, over the universal church, yet asserts the independence of national churches in many details of self-government and of local discipline, and limits the papal prerogatives by canons and decrees of general councils and by the laws of the universal church. It must be added that, while the Gallican theory to this extent claims exemption from the authority of the pope, it acquiesces, to an almost proportionate degree, in the assumption of ecclesiastical authority on the part of the state.

We can recognise the working of these principles in the opposition which the so-called Isidorian decretals (see CANON LAW) encountered in France. They were embodied, during the reign of St Louis, in the Pragmatic Sanction of 1269, which provided that the administration of the church should be in conformity with 'the common law, the canons of Councils, and the statutes of the ancient Fathers.' They were carried to their extreme extent by Philippe le Bel in his contest with Boniface VIII. The conflicting claims of the rival popes in the Western schism tended still more to weaken the papal authority; and the expedient of convening a general council to pronounce upon these claims gave prominence to one of the leading dogmas of Gallicanism—the superiority in point of authority of a general council to the pope. The disciplinary enactments of the councils of Constance and Basel were mainly directed towards the limitation of the papal authority in the exercise of church patronage; and these enactments were in the main embodied in the French law by the celebrated Pragmatic Sanction (q.v.) of Bourges in 1437.

The Pragmatic Sanction was superseded in 1516 by the Concordat of Bologna between Leo X. and Francis I. This treaty gave the nomination of bishops to the crown, and the right of instituting them to the pope, but it was with the greatest reluctance, and only 'at the express command of the king,' that the Parlement of Paris registered (1518) the papal bull that condemned the Pragmatic Sanction. The purely Gallican principles of the councils of Pisa, Constance, and Basel still remained the standard expression of French convictions as to the rightful position of the church. The great jurists Pithou and Dupin, in asserting the liberties of the church, equally enforced the privileges of the crown. It was a contest between Louis XIV. and Innocent XI. regarding the so-called right of Regalia—the right claimed by kings of receiving the revenues of a bishopric during a vacancy, and of presenting to benefices pending a new appointment—that led to the famous Declaration of the French Clergy in 1682, which has since been regarded as the charter of Gallicanism. This formulary emanated from an extraordinary assembly of 35 bishops and 35 other clergy convened by royal authority at Paris, 19th March 1682. It was drawn up by Bossuet, and consists of four articles. The first declares that 'the jurisdiction of St Peter and his successors in the Roman see as vicars of Christ on earth, although divinely bestowed, is confined to things spiritual and appertaining to salvation, and does not extend to civil or temporal affairs.' The article therefore declares 'that princes are not subject in temporal things to any ecclesiastical authority;' that they cannot be deposed 'either directly or indirectly by the power of the keys, and that their subjects cannot be dispensed from their subjection or released from their allegiance.' The second article renews the declaration of the Council of Constance with regard to the superiority of a general council over the pope, and declares that that article is not to be restricted in its application to a period of schism such as existed at the time of the council. The third asserts that the authority of the pope is 'to be restricted by the canons of the universal church,' and that 'the rules, customs, and institutions of the Gallican kingdom and church remain in full force.' This is the article which asserts the celebrated 'Gallican Liberties.' The fourth article, while it concedes to the pope 'the chief part in questions of faith,' and professes that 'his decrees extend to each and every church,' nevertheless maintains 'that his judgment is not irreformable, unless it shall have been confirmed by the consent of the entire church.' The chief rules, customs, and institutions of the Gallican Church referred to in the third article are, that the Gallican Church does not receive all the decrees of councils and of popes in matters of discipline, and that those only are in force which are so received; that the Gallican Church holds itself free to receive or reject the rules of the Roman chancery; that the Roman pontiff cannot levy any impost from the French clergy without their own consent; that he cannot bestow of his own motion on a foreigner any benefice within the French Church; that neither he nor his legates can hear French causes in 'the first instance,' and that in cases of appeal he is bound to assign native judges to hear the appeal, even if the appellant should be a metropolitan or primate; that the French bishops shall not be required to attend any general council except with the permission of

the crown. The last of these 'customs,' as also those which make the receiving or not receiving the general canons of discipline optional in France, and which practically throw the decision into the hands of the civil power, have been with much show of reason denominated the 'Slaveries' rather than the 'Liberties' of the Gallican Church.

This Declaration was strenuously enforced for the next ten years by Louis XIV. It was condemned by Pope Alexander VIII. in 1690, by Clement XI. in 1706, and again by Pius VI. in 1794; but both the acceptance of the articles and their condemnation were understood to be with certain reservations. The Gallican Church underwent very extensive modifications at the close of the 18th and the beginning of the 19th century. The enactment in 1790 of the 'civil constitution of the clergy' introduced a large infusion of the democratic element. The church was first secularised, and then swept away, till Bonaparte, as First Consul, restored it in a fresh concordat with the pope (1801). Yet the conflict with Rome still continued, and in 1810 a decree of the emperor made the declarations of 1682 once more the law of France. Pius VII. was forced by circumstances to enter into the concordat of Fontainebleau (1813), in which his right to the institution of bishops was not recognised, but on the advice of his cardinals his acceptance of this treaty was speedily recalled. After the Restoration the king agreed to a new concordat with the pope (1817), superseding the agreement of 1801, and returning to that of 1516; but this 'ghost of the past' found little favour with the French people, and in 1826 was met by a solemn declaration of all the bishops that they still adhered to the propositions of 1682. In 1830 the relations of church and state were again revised, and the freedom of all confessions was declared. The constitution of 4th November 1848 guaranteed payment by the state to the clergy of all religions recognised by the state then or at a later time. Under the Second Empire the influence of Rome steadily increased, spite of the ambiguous attitude of the emperor.

Within the 19th century the opinions of the French clergy underwent a decided change. The Gallican doctrines were much less commonly held, and in a less extreme form, and fell into great discredit with the church party. The climax of this reaction was seen in the conduct of the French bishops at the Vatican Council (1869–70), in which a great body of them were foremost in renouncing the Gallican articles and accepting the doctrine of papal infallibility; and even those who, like Bishop Dupanloup of Orleans, contended for the opposite view, in the end acquiesced in the decision of the majority. In France at the present day the old theological divergences seem to have passed out of view in presence of the conflict between the modern state and Ultramontanism.

The chief authorities are Pithou, *Les Libertés de l'Église Gallicane* (1594, 2 vols. fol. 1639); Dupuy, *Preuves des Libertés de l'Église Gallicane* (1638); and Bossuet, *Defensio Declarationis* (Luxemburg, 2 vols. 1730; French trans. 2 vols. Paris, 1735). See also De Maistre, *De l'Église Gallicane* and *Du Pape* (2 vols. 1820); Dupin, *Les Libertés de l'Église Gallicane* (Paris, 1824; new ed. 1860); Bordas-Demoulin, *Les Pouvoirs Constitutifs de l'Église* (1855); Huet, *Le Gallicanisme, son passé, sa situation présente* (1855); Puyol, *Études sur la Rénovation du Gallicanisme* (2 vols. 1876); W. H. Jervis, *History of the Church of France from the Concordat of Bologna, 1516 A.D., to the Revolution* (2 vols. Lond. 1872), and its sequel, *The Gallican Church and the Revolution* (1882).

Gallienus, PUBLIUS LICINIUS, Roman emperor from 260 to 268 A.D. His father, Valerian, had made him co-regent with himself in 253, but his reign ended when he was taken prisoner by the Persians seven years later. The authority of Gallienus was limited almost entirely to Italy, for throughout the provinces the legions for the most part revolted, and raised their commanders to the dignity of Cæsars. Hence the period is known in history as the Time of the Thirty Tyrants. In the East the honour of the Roman arms was maintained by Aurelian, Probus, and others, who found a useful ally in Odenathus, ruler of Palmyra, and his wife Zenobia, to whom Gallienus entrusted the care of the war against the Persians. In the West, however, dangers thickened about him. Aureolus was proclaimed emperor by the legions of Illyricum, and, having marched into Italy, he seized Milan, and proceeded towards Rome. The war between the two was carried on for some time with undecided success, but Gallienus, while besieging his adversary in Mediolanum (Milan), was murdered by some of his officers, 268 A.D. He was succeeded by Claudius II.

Gallinaceous Birds (Lat. *gallus*, 'a cock'), or RASORES (Lat., 'scrapers'), an old order of birds, including the Fowls, Sand-grouse, Hemipods—e.g. Turnex, and often also the Pigeons. The title Gallinæ is often still used to include the pheasant family (Phasianidæ), the grouse (Tetraonidæ), the sand-grouse (Pteroclidæ), the Turnicidæ, the mound-makers (Megapodiidæ), the curassows and guans (Cracidæ), the Tinamous (Tinamidæ), altogether over 400 species and about fourscore genera, and including forms of high antiquity. Interesting analogies have been pointed out between this order of birds and the order of Ruminants among Mammals, in the complexity of the digestive organs, bulkiness of the frame, low intelligence, easy domestication, usefulness to man, and proneness to variation from the influence of external circumstances, giving rise to different breeds. See POULTRY, GROUSE, PHEASANT.

Gallinule. See WATER-HEN.

Gallio, JUNIUS ANNÆUS, the Roman proconsul of Achaia under Claudius when St Paul was at Corinth, 53 A.D. He was brother of the famous Seneca, and had procured his name by adoption into the family of Gallio the rhetorician. He resigned the government of Achaia owing to ill-health, and later is said to have been put to death by Nero. The narrative in the Acts tells how, with regard to the clamour of the Jews against Paul, he was 'not minded to be a judge of these matters,' and how 'Gallio cared for none of these things;' hence his name has become a synonym for a careless, easy-going, and indifferent man who keeps himself free from trouble and responsibility.

Galliot, a Dutch vessel carrying a main and a mizzen mast, and a large gaff-mainsail. Galliots —strong-built, flat-bottomed ships—of 400 to 500 tons burden, were formerly used also as bomb-vessels. The word is ultimately a diminutive of Low Lat. *galea*, 'a galley.'

Gallip'oli (the *Kallipolis* of the Greeks), a town of Southern Italy, is built on a steep insulated rock in the Gulf of Taranto, connected with the mainland by a bridge, and is 59 miles by rail S. of Brindisi. The harbour is protected by a mole and fortified. The town contains a handsome cathedral, and is remarkable for its oil-tanks, excavated in the solid rock, in which olive-oil is deposited for exportation. Pop. 8083.

Gallipoli, a seaport of Turkey, on the peninsula of the same name (the ancient Thracian Chersonesus), at the north-eastern extremity of the Dardanelles, 90 miles S. of Adrianople, and 130 WSW. of Constantinople. The ancient *Kallipolis*, of which some ruins remain, it was formerly the

most important commercial town on the Hellespont, and still retains considerable trade. There are two harbours, extensive bazaars, and some manufactures. Gallipoli is the headquarters of the Turkish fleet, and the seat of a Greek bishop, and contains numerous mosques and fountains. The population is slightly over 15,000. The town was taken by the Turks in 1356, and formed their earliest European possession; and here the allies disembarked during the Crimean war.

Gallipot, the name given to a pot painted and glazed, commonly used for medicine. The word is a corruption of the Old Dutch *gleypot*, and already appears in Beaumont and Fletcher, *gley* being the same as the North Friesic *gläy*, 'shining,' and cognate with Ger. *glatt* and Eng. *glad*.

Gallitzin. See GALITZIN.

Gallium (sym. Ga, eq. 69·8) is a metal discovered by M. Lecoq de Boisbaudran in 1875 in a zinc-blende found in the Pyrenees. It has also been found in blendes from Asturia and from Bensberg. Strange to say, its properties and its salts were predicted before its existence was known by *Mendeleëff, in virtue of his Periodic Law* (see ATOMIC THEORY, Vol. I. p. 552). Gallium is of a bluish-white colour, and has a specific gravity of 5·9. It possesses the remarkable property of fusing at 30·1° C. (76° F.), and remaining liquid when cooled down even to 0°. If, however, the globule of molten metal be touched with a fragment of solid gallium, it at once solidifies. Heated to bright redness in contact with air gallium does not volatilise, and only a very thin coat of oxide is formed on the surface. Gallium, which has no industrial importance, dissolves readily in hydrochloric acid and in caustic potash with evolution of hydrogen. It forms one oxide, Ga_2O_3, which is insoluble in water, but soluble in potash and ammonia. The chloride, nitrate, and sulphate are all very soluble in water; the sulphate combines with ammonium sulphate to form an alum.

Gallomania. See ANGLOMANIA.

Gallon, the standard unit of measure for liquids throughout the United Kingdom. It has existed as a measure from the earliest times, and in consequence has undergone many changes. The oldest exchequer standards preserved in the Standards Office include a Winchester corn gallon, of a capacity of 274¼ cubic inches, constructed by order of Henry VII.; Queen Elizabeth added a standard ale gallon in 1601 of 282 cubic inches, and Queen Anne added in 1707 a standard wine gallon of 231 cubic inches. All these standard measures, however, were abolished in 1824, when the present imperial gallon, containing 10 lb. of distilled water, weighed in air (the barometer being at 30 inches, and the thermometer at 62° F.), was made the standard of capacity for liquid measures. This gives 277·274 cubic inches, and by subdivision or multiplication of this standard the other measures can easily be found. See WEIGHTS AND MEASURES.

Gallotannic Acid, a synonym of Tannic Acid (q.v.). See also GALLIC ACID.

Galloway, an extensive district in the south-west of Scotland, once somewhat larger, but now entirely comprised in the shire of Wigtown and stewartry of Kirkcudbright. It enjoys a remarkably mild climate, and has long been famous as a pastoral country, its breed of small horses and of large hornless black cattle being well known centuries ago; but the enormous improvement of agriculture under the fostering care of two generations of singularly public-spirited landlords has made dairy-farming now the most important industry. The province is about 70 miles in length by 40 at its utmost breadth, and contains the greatest diversity of scenery—mountain, lake, and stream, as well as dreary waste and almost pathless moor. There is no mineral wealth and hardly an industry, hence the inhabitants are almost entirely concerned with the primitive occupations of man—tilling the soil, sheep and cattle rearing, and fishing. They are simple, honest, and hospitable, with almost every virtue proper to a peasantry save severe morality. A more detailed account of the country and its productions will be given under the heads KIRKCUDBRIGHT and WIGTOWN.

The province owes its name to the fact that the natives were called Gall-Gael, or foreign Gaels, at first because of their falling under the foreign rule of the Anglians; but as the Picts of Galloway they continued to be known so late as the Battle of the Standard in 1138. Their geographical position had shut them off from their northern congeners, and they continued under their ancient names a distinct people till the 12th century, and preserved their language—which was substantially identical with Gaelic—till the 16th, when it finally disappeared before the Reformation and the use of Lowland Scotch in the parish churches and schools, leaving only a rich crop of place-names wonderfully similar to those of Ireland and the south-western Highlands of Scotland. The earliest inhabitants are styled by Ptolemy the *Novantæ*, to the west of the Nith, with two towns, *Lucophibia* at Whithorn and *Rerigonium* on the eastern shore of Loch Ryan; and the *Selgovæ*, covering Dumfriesshire, with the towns *Trimontium*, *Uxellum*, *Corda*, and *Carbantorigum*, the sites of which are placed by Mr Skene on Birrenswark Hill, on Wardlaw Hill, at Sanquhar, and at the moat of Urr, between Nith and Dee. Tacitus tells us that Agricola concentrated a force in that part of Britain which looks on Ireland, and most authorities identify this with Galloway rather than, as Mr Skene, with the modern county of Argyll. This view is borne out by the discovery of Roman forts in Wigtownshire and the Stewartry in situations corresponding with those of the towns of the Novantæ described by Ptolemy as existing in the time of Hadrian. Galloway was subdued by the Northumbrian Anglians of Bernicia during the 7th century, and governed by them for about two hundred years, and it was to this period apparently that the modern name is due. After about three centuries of more or less complete independence, interrupted only by Norse ravages and at length by a period of Norse supremacy, it was recovered by Malcolm Canmore, granted as an earldom in 1107 to his youngest son David, and on his accession to the throne in 1124 formally united with Scotland. Of the native lords of Galloway we read of a doubtful 'Jacobus, rex Galwalliæ' as one of the eight tributary princes who waited on Edgar at Chester in 973. A more historical figure is Fergus, appointed first Earl of Galloway, after the fall of Ulgric and Duvenald, lords of the Galivenses, at the Battle of the Standard. With Somerled he made an unsuccessful revolt against Malcolm IV., and was obliged to give his lordship to his sons, Uchtred and Gilbert, who in their turn, when William the Lion was taken prisoner at Alnwick in 1174, attempted, but in vain, to throw off the Scottish yoke, even offering fealty to England. Roland, a son of Uchtred, did homage to Henry II. of England, and his son Alan, who succeeded in 1200, was one of the barons who forced John to sign Magna Charta, but seems later to have returned to his Scottish allegiance. At the dispute for the Scottish crown, which opened in 1291, the lordship of Galloway through descent and marriage was in the hands of John Baliol, Alexander Comyn, and two others; consequently the Galwegians resisted

Robert Bruce in his struggle with England for the Scottish crown. The province was traversed successively by Wallace, Edward I., and Bruce, and was at length subdued for his brother by Edward Bruce in 1308. Again in 1334 it was seized by Edward Baliol, but his power was at length overthrown, and in 1369 the eastern part of Galloway was granted by the crown to Archibald *Douglas, surnamed the Grim, who* built himself the stronghold of Threave Castle on a small island in the Dee. His haughty and turbulent descendants built up a power so formidable as to threaten the crown itself, until they fell finally in 1455, when the lordship of Galloway was attached to the crown. These ages of troubles had generated a turbulent spirit among the Galwegians, and it was long before they settled down into peaceful and industrious citizens. They achieved a more honourable eminence by their devoted loyalty to the Covenant, which they had embraced with all their ancient ardour. Not all the infamous cruelties carried out at the bidding of a corrupt government by Turner, Grierson, and Claverhouse could crush the spirit of these 'wild western Whigs' whose martyr-graves are scattered over the moors of Galloway.

See Symson's *Description of Galloway, 1684* (1823); Murray's *Literary History of Galloway* (1822); Mackenzie's *History of Galloway* (2 vols. Kirkc. 1841); Sir Andrew Agnew's *History of the Hereditary Sheriffs of Galloway* (1864); P. H. M'Kerlie's *History of the Lands and their Owners in Galloway* (5 vols. 1870–78); Sir Herbert E. Maxwell's *Studies on the Topography of Galloway* (1887); and C. I. Elton's article, 'The Picts of Galloway,' in vol. i. of the *Archæological Review* (1888).

Galloway, Mull of, a bold headland of precipitous rock, the southern extremity of the peninsula called the Rhinns of Galloway, in Wigtownshire, and the most southern point of Scotland. It is 1¼ mile long, and ¼ of a mile broad, and rises to a height of 210 feet at its eastern extremity, on which stands a lighthouse 60 feet high, whose intermittent light is visible at a distance of 23 nautical miles. The summit of the lighthouse commands a magnificent prospect of sea and sky, extending to the Isle of Man, 23 miles to the south, to the coast of Ireland, 26 miles to the west, and sometimes even to the Cumbrian mountains, more than 50 miles distant. The Mull is part of the parish of Kirkmaiden, and is 5 miles from Drumore and 23 south of Stranraer.

Gallowglass, a heavy armed foot-soldier in the ancient Irish wars. They are grouped with *kernes* in Shakespeare's *Macbeth* (I. ii. 13) as coming from the western isles of Scotland. The word is of course Irish, formed from *giolla*, 'a man-servant,' and cognate with the well-known *gillie*.

Galls (when large, dry, and nut-like often called Gall-nuts, also *Nut-galls* and *Oak-apples*) are the abnormal vegetative growths produced in various plants through the introduction of the eggs, and the development of the larvæ of the various gall-insects. The economic usefulness and consequent commercial importance of so many of the larger forms, essentially due to the presence of a large quantity of tannic acid, will be noticed under Tanning. See also Gall-fly, Gallic Acid.

Gall-stone. See Calculus.

Gallus, C. Cornelius, a Roman poet, born at Forum Julii (mod. Fréjus), in Gaul, about 66 B.C. He lived at Rome in intimate friendship with Virgil, Asinius Pollio, Varus, and Ovid, and was appointed by Augustus prefect of Egypt, but fell deservedly into disfavour and was banished, whereupon he ended his disgrace with his own sword about the year 26 B.C. Gallus was reckoned the founder of the Roman elegy, from his four books of elegies upon his mistress Lycoris, of which but a few slight fragments have come down to us. His name was adopted by W. A. Becker as the title of his well-known picture of Roman domestic life: *Gallus, Römische Szenen aus der Zeit Augusts* (1838). See Völker, *Commentatio de C. Galli vita et scriptis* (1840–44).

Gallus, Trebonianus, Roman emperor (251–253 A.D.), was the successor of the ill-fated Decius, and is memorable only from the dishonourable peace which he purchased from the Goths, followed by a dreadful pestilence in Italy. His end was to be murdered by his own soldiers.

Galop, a lively kind of dance of German origin, somewhat resembling a waltz, danced in ⅔ time. See Dancing.

Galston, a village of Ayrshire, 5 miles SE. of Kilmarnock by rail, with manufactures of muslins and lace. There is coal in the neighbourhood. Pop. 4085.

Galt, a town of Canada, province of Ontario, stands on the Grand River, 25 miles by rail E. by N. of Hamilton. The environs of the town are noted for their beauty. The chief industries are the manufacture of flour, machines, cast-iron, paper, wooden ware, and leather. Galt was founded in 1816. The inhabitants numbered 5187 in 1881, the majority being of Scotch descent.

Galt, John, Scotch novelist, was born at Irvine, in Ayrshire, May 2, 1779. His father, who was captain of a ship in the West Indian trade, left Ayrshire in 1780, and fixed his residence in Greenock. In that town Galt received his education, and was then placed in the custom-house. He remained there till 1804, when, panting for literary distinction, he proceeded to London with an epic poem on the battle of Largs in his portmanteau. On reaching the metropolis he printed his epic, but, becoming dissatisfied with its merits, ultimately withdrew it from the market. After a few years his health began to fail, and he was obliged to seek relief in a more genial climate. At Gibraltar he made the acquaintance of Lord Byron and his friend Hobhouse, and the three travellers became fellow-voyagers; but soon after Galt separated from his new friends to visit Sicily, then Malta, and finally Greece, where he again renewed his acquaintance with Byron, and had an interview with Ali Pacha. He next proceeded to Constantinople, and afterwards to the shores of the Black Sea. On one occasion when detained by quarantine he sketched six dramas which were afterwards given to the world. On his return he published with considerable success his *Letters from the Levant*, but first displayed distinct and individual power in *The Ayrshire Legatees*, which appeared in *Blackwood's Magazine* in 1820. Its successor, *The Annals of the Parish* (1821), met with unquestionable success, and remains his masterpiece. Having hit on the true vein he worked it assiduously, and produced in quick succession *Sir Andrew Wylie*, *The Entail*, *The Steamboat*, and *The Provost*. He then diverged into the walk of historical romance, and published *Ringan Gilhaize*, a tale of the Covenanters; *The Spaewife*, *Rothelan*, and *The Omen*. These works, although full of striking scenes and really good writing, were not so successful as his earlier and less ambitious performances. Galt, whose hands were always equally full of literary and commercial undertakings, was now busily engaged in the formation of the Canada Company; but before he left England for his distant scene of labour he gave to the world *The Last of the Lairds*.

He departed for Canada in 1826, but three years later returned to England a ruined man, and at once recommenced his literary labours with his

usual rapidity. His first novel was *Lawrie Todd*, which was followed by *Southennan*, a romance of the days of Queen Mary; and this by a *Life of Lord Byron*, which ran through several editions, but which was roughly handled by the critics. In 1834 he published his *Literary Life and Miscellanies* in three volumes. He now returned to Scotland, utterly broken in health and spirits, and after suffering several attacks of paralysis, died at Greenock, 11th April 1839.

Galt was a voluminous and unequal writer, but while some of his productions are already forgotten, others will perish only with the language. In depicting provincialism, in representing life as it flows on in small towns and villages—communities in which the successful shopkeeper may aspire to be the chief magistrate, and in which the minister is the most important personage—he is without a rival. He possesses rich humour, genuine pathos, and a rare mastery of the Scotch dialect.—His son, Sir ALEXANDER TILLOCH GALT, born at Chelsea, 6th September 1817, was elected to the Canadian parliament in 1849, and was finance minister in 1858–62 and 1864–66. In 1880–83 he was High Commissioner for Canada in Britain; and he served on the Washington Treaty and Halifax Fisheries Commissions. He is a G.C.M.G.

Galton, FRANCIS, F.R.S., grandson of Dr Erasmus Darwin, and cousin of Charles Darwin, was born at Duddeston in 1822, and educated at King Edward's S[illegible] He studied medicine at the [illegible] and King's College, London, and graduated from Trinity College, Cambridge, in 1844. Having in 1846 travelled in North Africa, he explored in 1850 lands hitherto unknown in South Africa, publishing his experiences in his *Narrative of an Explorer in Tropical South Africa*, which obtained the gold medal of the Royal Geographical Society, and in *Art of Travel*, which passed through five editions between 1855 and 1872. His investigations in meteorology are recorded in *Meteorographica*, published in 1863. A member of a Meteorological Committee of the Board of Trade, he was appointed one of the committee entrusted with the parliamentary grant for the Meteorological Office. Latterly he has specially devoted himself to the problem of heredity, publishing *Hereditary Genius: its Laws and Consequences* (1869); *Experiments in Pangenesis* (1871); *English Men of Science: their Nature and Nurture* (1874); *Life-history Album* (1884); *Natural Inheritance* (1889), &c. He was general secretary of the British Association, 1863–68; President of the Anthropological Sections, 1877 and 1885; President of the Anthropological Institute, 1885–86.

Galvani, LUIGI, a famous anatomist, was born at Bologna, 9th September 1737, studied theology and subsequently medicine at the university there, and in 1762 was elected professor of Anatomy. His lectures enjoyed much popularity, and among other writings two treatises on the organs of hearing and on the genito-urinary tract in birds added considerably to his reputation. But Galvani owes the wide celebrity attached to his name to his discoveries in animal electricity. The story of the convulsive muscular movements produced in a skinned frog by a chance contact with a scalpel may be dismissed as unfounded; there is evidence that Galvani's views were based on experiments patiently conducted for many years before the publication of his *De viribus Electricitatis in Motu Musculari Commentarius* (1791). He was removed for a time from his post because of his refusal to take the oaths prescribed by the Cisalpine Republic, of which Bologna then formed a part; but he was afterwards reinstated, and died 4th December 1798, in Bologna, where his statue was erected in 1879. Most of his writings were published in a quarto edition in 1841–42 by the Academy of Sciences of his native city; but several manuscript treatises by him were discovered there in April 1889.

GALVANISM is one of the names of a particular branch of the science of electricity, given in honour of Luigi Galvani, from whose observations and experiments the historical development of current electricity dates. The term itself is rarely used now; and the subject will be found treated under ELECTRICITY. There are, however, other expressions which have been derived from the same source, and which are in common use. Such are galvanic current, galvanic cell, galvanic battery, and galvanometer. *Voltaic* may be, and very often is, used in place of *galvanic* in the first three expressions; but galvanometer is the one name for an instrument which measures the strength of an electric current by means of its effect upon a neighbouring magnet. The gradual disuse of the term galvanism is probably due to the recognition in these later times of the fact that, although Galvani's experiments were the beginning of the new era in electricity, it is to Volta that we are specially indebted for the development of the science along purely physical lines.

Galvanised Iron. This name is given to iron which has been coated with zinc to prevent its rusting. The iron is simply dipped in the melted zinc, and the name does not imply, as might be supposed, that any definite galvanic process is undergone. Galvanised iron first came into use about 1837, when iron cooking-vessels were treated in this way. Since then tinned iron has come into use for cooking-vessels, and galvanised iron is now employed chiefly for roofing purposes, buckets, telegraph wire, chains, &c. The process of manufacture is very simple. The zinc is melted, and dry sal-ammoniac poured on the top. This fuses and forms a protecting layer, keeping the surface of the metal clean. The iron plates or vessels, having been carefully cleansed by means of dilute hydrochloric acid and scrubbing with sand, are now introduced into the molten zinc, which immediately forms an alloy with the iron, and renders it incapable of rusting. Care must be taken not to immerse the iron for too long a time, for the alloy of zinc and iron melts at a comparatively low temperature, and there is a danger of destroying the vessel which is being galvanised. Galvanised iron is not so tough as iron itself, but still the freedom from rusting makes it specially applicable for many purposes. Galvanised iron water-pipes are now much employed in houses, but steam-pipes of this material are unsatisfactory: when exposed continuously to a moist steam heat, galvanised iron seems to become corroded, and small holes make their appearance. Galvanised iron is, of course, unsuitable where any acid is present, and any preparation containing vinegar will assume a disagreeable taste if placed in a galvanised vessel.

Galveston, a seaport of Texas, and the largest city of the state, is situated on Galveston Island, at the opening of the bay of the same name into the Gulf of Mexico, 214 miles ESE. of Austin by rail. The island is a low strip of land, some 30 miles long by 3 broad; the bay extends northward from the city to the mouth of the Trinity River, a distance of 35 miles, and has a breadth of from 12 to 18 miles. The city contains a Catholic cathedral, the Catholic University of St Mary, and the Texas Medical College; and it has several foundries, flour and planing mills, and machine-shops. Its harbour is the best in the state, protected since 1887 by a breakwater; and steamers make regular passages to New Orleans and the Gulf ports,

Havana, New York, and Liverpool. Cotton and cotton-seed oil form the great bulk of the foreign exports, and in 1887 exceeded $17,000,000; the foreign imports in the same year reached $1,765,612, while the trade with the other states of the Union aggregated $110,000,000 (imports, $80,000,000; exports, $30,000,000). Pop. (1850) 4177; (1870) 13,818; (1880) 22,248; estimated in 1889 at 50,000.

Galway, a maritime county of Ireland, in the province of Connaught, and, after Cork, the largest of all the Irish counties. Area, 1,569,505 acres, of which a little more than one-half is arable. Pop. (1831) 414,684; (1871) 248,458; (1881) 241,662, of whom 234,183 were Roman Catholics. It is watered in the east by the Shannon, the Suck, and their feeders; and in the west by Loughs Mask and Corrib, and by the streams which fall into these loughs and into Galway Bay. In the south are the Slieve-Baughta Mountains; and in the west are the Maam-Turk Mountains, and the well-known Twelve Pins, a striking mountain group, culminating in Benbaun (2395 feet). This western portion of the county is wild and romantic; the hills are separated by picturesque glens, and by secluded and beautiful loughs. South-west from Lough Corrib to the sea is the district called Connemara, which contains vast bogs, moors, lakes, and morasses, and presents a peculiarly bleak and dreary aspect. North-east of Connemara is Joyce's Country, and south-east of it is Iar-Connaught, or Western Connaught. The shore is much broken, offering many bays that serve as harbours for large vessels, and is fringed with numerous islands. The climate is mild and humid, but in low-lying localities is sometimes unhealthy. The richest soil occurs in the district between the head of Galway Bay and the Shannon. Agriculture and fishing are the most general pursuits. The lakes and loughs, as well as the coasts of Galway, are well stocked with fish. The county abounds in ancient remains of the Celtic as well as of the English period. Raths and cromlechs are numerous; there are seven round towers; whilst of many monastic ruins the finest is that of Knockmoy, near Tuam. Since 1885 Galway county has returned four members to parliament.

GALWAY BAY is an inlet of the Atlantic Ocean, on the west coast of Ireland, between the counties of Galway and Clare. It is a noble sheet of water, and offers great facilities for an extended commerce—being 30 miles in length from west to east, with an average breadth of about 10 miles, and is sheltered by the Arran Isles.

Galway, a municipal and parliamentary borough of Ireland, a seaport, and county of itself, stands at the mouth of the river Corrib, on the north shore of Galway Bay, 50 miles NNW. of Limerick, and 127 W. of Dublin by rail. The old town of Galway is poorly built and irregular. In the wall of a house here is the 'Lynch Stone,' bearing a skull and crossbones, and commemorating a mayor of Galway, James Lynch Fitzstephen, commonly called 'Mayor Lynch,' who, in 1493, like Brutus of old, condemned his own son to death for the murder of a Spaniard, and to prevent his being rescued, actually caused him to be hanged from a window of the old prison on that site. Hence some have derived Lynch Law (q.v.). The new town consists of well-planned and spacious streets, and is built on a rising-ground which slopes gradually toward the sea and the river. A suburb, called Claddagh, is inhabited by fishermen, who exclude all strangers from their society. Galway is the see of a Catholic bishop, but is in the Protestant Episcopal diocese of Tuam. The principal buildings are the cruciform church (Episcopal) of St Nicholas (1320), St Augustine's Catholic Church (1859), monasteries, nunneries, the county court-house, barracks, prison, infirmary, &c. Queen's College (1849) has eighteen professors and about a hundred students; its quadrangular buildings are spacious and handsome. Galway has flour-mills, a distillery, a foundry, extensive salmon and sea fishing, a good harbour, with docks that admit vessels of 500 tons, and a lighthouse. During 1858-64 a line of steamers plied between Galway and the United States. The exports consist mainly of agricultural produce, wool, and black marble. Galway returns one member to parliament. Pop. (1851) 20,686; (1881) 15,471, of whom nine-tenths are Catholics.

Galway was taken by Richard de Burgh in 1232, and the ancestors of many of the leading families now resident in this quarter settled here about that time. From the 13th till the middle of the 17th century the place continued to rise in commercial importance. In 1652 it was taken by Sir Charles Coote after a blockade of several months; and in July 1691 it was compelled to surrender to General Ginkell. See Hardiman's *History of the Town and County of Galway* (Dublin, 1820).

Gama, VASCO DA, the greatest of Portuguese navigators, was born about 1469, of good family, at Sines, a small seaport in the province of Alemtejo. He early distinguished himself as an intrepid mariner, and, after the return of Bartolomeu Diaz in 1487 from his venturesome voyage past the Cape of Storms had determined King João to make explorations farther, was appointed by his successor, Manoel the Fortunate, to command an expedition of four vessels, manned with 160 men. At the same time he was furnished with letters to all the potentates he was likely to visit, among them the mythical 'Prester John,' then supposed to be reigning in splendour somewhere in the east of Africa. The little fleet left Lisbon 8th July 1497, but was vexed by tempestuous winds almost the whole way, and was four months in reaching St Helena Bay. After rounding the Cape, in spite of dreadful storms and mutinies among his crews, he made Melinda early in the following year. Here he found a skilful Indian pilot, next steered eastwards across the Indian Ocean, and arrived at Calicut, in India, on the 20th of May 1498. The zamorin or ruler of Calicut was at first merely suspicious, but soon became, at the instigation of the jealous Arab merchants, actively hostile, until at length Da Gama had to fight his way out of the harbour. In September 1499 he cast anchor at Lisbon, and was received with great distinction, and created a noble.

King Manoel immediately despatched a squadron of thirteen ships, under Pedro Alvarez Cabral, to establish Portuguese settlements in India. Sailing too far westwards he discovered the unknown coast of Brazil, and, after losing half his ships, at length made Calicut, where he founded a factory. Here, after Cabral's departure, the forty Portuguese who had been left behind were murdered by the natives. To avenge this insult and secure the Indian Ocean commerce the king fitted out a new squadron of twenty ships, which set sail under Da Gama's command in 1502, founded the Portuguese colonies of Mozambique and Sofala, bombarded Calicut, destroyed a fleet of twenty-nine ships, and extorted a peace with suitable indemnification, and reached the Tagus with thirteen richly-laden vessels before the close of December 1503. Da Gama had effected his purpose with marvellous despatch, but not without cruelties that have left an indelible stain upon his name. For the next twenty years he lived inactive at Evora, while the Portuguese conquests in India increased, presided over by five successive viceroys. The fifth of these was so

unfortunate that King João III., the successor of Manoel, was compelled in 1524 to summon Da Gama from his seclusion and despatch him, with the title of viceroy and a fleet of thirteen or fourteen vessels, to the scene of his former triumphs. His firmness and courage succeeded in making Portugal once more respected in India, but while engaged in his successful schemes he was surprised by death at Cochin in December 1525. His body was conveyed to Portugal, and buried with great pomp at Vidigueira. The great achievement of Vasco da Gama is one of the most important points in the history of modern civilisation, second only in importance to the discovery of America by Columbus but a few years before. His story gave its impulse to the enthusiasm of Camoens, whose *Lusiads* would alone have given the subject immortality. See the *Three Voyages of Vasco da Gama*, trans. by Lord Stanley of Alderley for the Hakluyt Society (1869).

Gamaliel (*Gamli'el*, 'my rewarder is God'), a Hebrew name, the most celebrated bearer of which is Gamaliel I., or the Elder (so called to distinguish him from his grandson), probably the one mentioned in the New Testament, at whose feet St Paul learned the 'law.' Both here and in the Talmudical writings he appears only in his capacity of a teacher of the law and a prominent Pharisaic member of the Sanhedrim; of the circumstances of his life we know little but that he taught early in the 1st century, and that he interposed on behalf of the apostles of Christianity. He was the son of Simeon, and grandson of Hillel (q.v.). Laws respecting the treatment of the Gentiles, due directly or indirectly to Gamaliel's influence, show unusual breadth and toleration. The Gentile, it was enacted, should henceforth, like the Jew, be allowed the gleanings of the harvest-field; of his poor the same care was to be taken, his sick were to be tended exactly as if they belonged to the Jewish community. Tolerant, peaceful, as free from fanaticism on the one hand as on the other from partiality for the new sect, he seems to have placed Christianity simply on a par with the many other sects that sprang up in those days and disappeared as quickly; and he exhorts to long-suffering and good-will on all sides. When Gamaliel died (about seventeen years before the destruction of the Temple) 'the glory of the law' was said to have departed. The story of his conversion to Christianity, we need scarcely add, is as devoid of any historical foundation as that of the transmission of his bones to Pisa. Yet his name has been placed on the list of Christian saints, his day being the 3d of August.

Gamba. See VIOL DI GAMBA.

Gambetta, LÉON MICHEL, French statesman, was born at Cahors, of Genoese-Jewish extraction, October 30, 1838. After studying law, he became a member of the Paris bar in 1859. He soon attracted attention by his advanced liberal views, and in 1868 acquired still greater celebrity by his striking speech in the Baudin case, and his denunciations of the arbitrary measures of Louis Napoleon. In 1869 he was elected deputy by the Irreconcilables for both Marseilles and Belleville, and took his seat for the former constituency. Early in the session of 1870 he protested against the imprisonment of his friend Rochefort, attacked the ministry of Émile Ollivier, and predicted the approaching advent of the Republic. Upon the surrender of Napoleon III. at Sedan, Gambetta proposed the deposition of the imperial dynasty, and he was one of the proclaimers of the Republic, September 4. On the 5th he became minister of the Interior in the Government of National Defence, and at once took vigorous measures for opposing the Germans and defending Paris. The capital, however, was invested, and in October he escaped in a balloon in order to join his colleagues at Tours. Here, and subsequently at Bordeaux, he assumed the general conduct of public affairs, and for five months was Dictator of France. With marvellous energy and undaunted courage he called army after army into being, and sent them against the German hosts, but in vain. The trumpet-tones of his appeals were heard throughout the whole of France, and at one moment it seemed as though success must attend the efforts of the indefatigable minister; but the surrender of Metz by Bazaine—which Gambetta denounced as an act of treason—crushed all hopes of deliverance for France. Nevertheless, Gambetta continued the struggle, and even when Paris succumbed to the invaders he demanded that the war should be carried on *à l'outrance*, and that an assembly should be elected for that purpose. When his colleagues in the capital had concluded an armistice, and called upon the electors without regard to party to elect a constituent assembly, Gambetta issued a decree at Bordeaux, January 31, 1871, disfranchising all functionaries of the Empire and all members of royal dynasties. This decree was repudiated by the government at Paris, whereupon Gambetta resigned, and for some months retired into Spain. But he became more popular than ever with the masses, and was elected to the National Assembly by ten departments. He took no part in the earlier sittings of the Assembly or in the suppression of the Commune. In July he was re-elected for the departments of the Seine, Var, and Bouches-du-Rhône, and took his seat for the last-named department. The *République Française* appeared in November 1871 as his representative organ.

The second part of Gambetta's political career began after the fall of the Commune, when he was accepted as the chief of the advanced Republicans. Early in 1872 he traversed the south of France, exciting the enthusiasm of the populace, and in the ensuing September he formulated the Republican programme at Grenoble, severely attacking M. Thiers and the National Assembly, and demanding the removal of the government from Versailles to Paris. He had now become the most prominent Frenchman of the time. The National Assembly voted the republican form of constitution in February 1875, and two months later Gambetta delivered his famous speech at Belleville, defending the Republicans from the attacks of the Irreconcilables. The '*fou furieux*' of M. Thiers now developed into the leading exponent of Opportunism. He opposed the vote of the Assembly establishing *scrutin d'arrondissement*, and after the elections of 1876 became president of the budget committee. A constitutional conflict arose in May 1877, when the Duc de Broglie took office in the hope of restoring the monarchy. A civil war seemed imminent, but, owing chiefly to the zeal and activity of Gambetta, such a catastrophe was averted, and the Republic firmly established. The chamber censured the ministry by 363 to 158 votes, and a dissolution was ordered. Gambetta exclaimed, 'We go out 363, and 363 we shall return,' and his prophecy was fulfilled to the letter. Marshal MacMahon refrained from pushing matters to an extremity, and the royalist contest was abandoned. Gambetta was summoned before the Eleventh Correctional Tribunal of Paris for having declared respecting MacMahon at Lille, '*Il faudra ou se soumettre, ou se démettre.*' He was condemned on October 24 to three months' imprisonment and a fine of 4000 francs. Two months later he was re-elected for Belleville. The

contest between the deputy and the president ended in the triumph of Gambetta—who did not go to prison—and the resignation of MacMahon. M. Grèvy was elected president, but Gambetta was regarded as the saviour of the Republic. Though now the most powerful statesman in France, and the maker and unmaker of cabinets, he declined to take office, on the ground that no strong government was possible until the elective *scrutin de liste* had been adopted. In 1878 Gambetta fought a duel with M. de Fourton, an ex-minister, whom he had charged with falsehood, but the hostile encounter had a harmless termination. Shortly afterwards Gambetta accepted the presidency of the chamber, a post which he held till the autumn of 1880. In November of that year the Ferry ministry resigned, being discredited by the mismanagement of the Tunis expedition. Gambetta was called upon to form a cabinet, and succeeded, after much difficulty. But, as it was practically a government of one, opposition to the new premier set in, and when he produced his scheme for the revision of the constitution in January 1882 the chamber rejected the *scrutin de liste* proposal by 305 to 110 votes, and Gambetta immediately resigned. He afterwards acted as chairman of the military committee, but took little part otherwise in public affairs.

On 26th November, as he was handling a revolver at his residence at Ville d'Avray, the weapon accidentally went off, and the bullet entered the palm of his hand and came out at the wrist. A report subsequently prevalent asserted that the wound was inflicted by a woman's hand. In any case, no serious consequences were apprehended, and in spite of sinister rumours he was reported convalescent on 13th December. The wound, however, took an unfavourable turn; internal inflammation set in, and the patient suffered terrible agony. Yet he was conscious and self-possessed until the end, and expired on the last day of the year 1882, being only forty-four years of age. He was buried at Nice, France mourning for him as one of the greatest of her patriots and sons, and as one who, by his dauntless will, energy, and eloquence, had indelibly impressed himself upon one of the darkest periods of her national history. Reinach has edited his *Discours Politiques* (10 vols. 1880–84), and written a Life of him (1884).

Gambia, a river of Western Africa, the more southerly of the two great streams of Senegambia, enters the Atlantic after a course estimated at over 1400 miles, by an estuary which in some parts measures nearly 27 miles across, but contracts to little more than 2 at the mouth (Bathurst, 13° 24′ N. lat., 16° 36′ W. long.). It is navigable from June to November for vessels of 150 tons up to Barraconda, about 400 miles from the sea. The whole of the *lower* river, extending to Georgetown, 180 miles from Bathurst, is British waters. Below Barraconda the river overflows its banks in the rainy season, and, like the Nile, leaves a fertile deposit of mud.—The British settlement of Gambia occupies the banks of the river as far up as Georgetown, though not continuously. Its actual area is about 69 sq. m., embracing St Mary's Island, a sandbank about 3½ miles long by 1¼ broad, mostly covered with low swamps, but containing Bathurst (q.v.); British Combo, on the mainland opposite; Albrida, on the north bank; the Ceded Mile; and M'Carthy's Island, with Georgetown. The climate is officially described as only 'fairly healthy during the dry months.' Besides the weaving of cotton into native cloths, there are manufactures of vegetable oils and bricks, and some boat-building. The staple product is the ground-nut, which is exported to the south of Europe for the extraction of oil, although this trade has declined since 1858. Other products are hides, rice, cotton, beeswax, kola nuts, and india-rubber, and there is an active entrepôt trade with the neighbouring French settlements in cotton goods, spirits, rice, kola nuts, and hardware. In the ten years 1878–87 the imports (mostly British) ranged from £217,938 in 1884 to £69,243 in 1886; the exports (chiefly to France) from £254,711 in 1882 to £79,516 in 1886. The revenue in the same period ranged from £28,952 to £13,453, but the expenditure never fell below £18,361. Formerly a dependency of Sierra Leone, the settlement was created an independent colony in 1843, and became a portion of the West African Settlements in 1876; in 1888 it was made a separate government. The settlement is connected with Europe by telegraph cables, and the Liverpool mail-steamers call fortnightly. There are 14 denominational schools (8 Mohammedan), receiving grants in aid, with about 1300 pupils. Pop. (1881) 14,150, including some 25 Europeans.

Gambier, GAMBIR, or PALE CATECHU, is an important article of commerce, used to a small extent medicinally as an astringent, but very largely in tanning and dyeing. It is an earthy-looking, light-brown substance, often in small cubes or in compact masses. It possesses no odour, but has a bitter, astringent taste, subsequently becoming sweetish. Under the microscope it is seen to consist of small acicular crystals. It is prepared in a very rude manner from the young leaves of the *Uncaria Gambir*, a native of the countries bordering the Straits of Malacca. As the plant, which grows to 8 or 10 feet, constantly produces young leaves, the manufacture is carried on throughout the year. The leaves are boiled in water, squeezed, and the decoction evaporated to a thick consistence, when it is poured into buckets, and treated in a curious manner. The workman takes a stick, which is moved up and down in the mass, and, as the gambier dries on it, it is scraped off and allowed to harden. It is asserted that stirring the mass does not produce an equally good article.

Gambier, JAMES, BARON, Admiral, was born in the Bahamas, 13th October 1756, entered the navy, and off Ushant fought with distinction as commander of the *Defence* under Lord Howe in 1794. As admiral he commanded the British fleet at the bombardment of Copenhagen in 1807, and was rewarded with a peerage. At the battle of Aix Roads in 1809 he refused to act on the advice of Lord Cochrane (see DUNDONALD), was tried by court-martial, and 'most honourably acquitted.' He attained the high rank of Admiral of the Fleet in 1830, and died 19th April 1833. The *Memorials* of him (1861) by Lady Chatterton has no value.

Gambier Islands, or MANGARÉVA, a Polynesian group of six larger and several smaller islands, under a French protectorate, in 23° 8′ S. lat. and 134° 55′ W. long. Area, 15 sq. m. The pop., under 1000, are Catholics. Pearls and mother-of-pearl are the chief exports.

Gambit. See CHESS.

Gambling, or GAMING, may be defined as the practice of playing for a money stake games depending solely on chance, like *roulette*, for instance, or those other games into which the element of skill enters, as in the cases of whist or billiards. Gambling was not countenanced by the Roman law; but a curious exception seems to have been made when, by the terms of the wager, the loser had to provide refreshment or hospitality for the winner. Before the passing of an enactment for the restriction of games and gaming, all games like cards and dice, and all exercises, were legal at common law so long as they were indulged in for recreation and played fairly and without

cheating; and the reason assigned for the favour which gambling finds with the majority is not inaptly stated by a writer in the time of Queen Anne. He says: 'I cannot attribute it to a principle of mere avarice in many, though in most I fear it is so, but rather think the contingency of winning and losing and the expectations therefrom are diverting. I conceive there would be no pleasure properly so called if a man were sure to win always. It 's the reconciling uncertainty to our desires that creates the satisfaction.' Among the old writers the subject of gaming appears to have taken a wide scope, and to have been mixed up with games which might more properly be ranked under the head of athletic exercises, as well as with what our ancestors were pleased to regard as sport; and the same classification appears to have taken place in some of the older statutes. Statutory restrictions upon games and gaming go back as far as the 12th year of the reign of Richard II., and these were followed by the 17th of Edward IV. and others which made certain games illegal; but in giving an outline of the chief statutes connected with gaming it is unnecessary to go further back than the year 1541, as the comprehensive Act 33 Henry VIII. chap. 9 prohibited tables, tennis, dice, cards, bowls, dash, loggats, and other unlawful games when played under certain conditions. This statute, however, like one of Edward III.'s proclamations, had for its immediate object the encouragement of archery, and professes to have become law in consequence of a petition being presented by the bowmen of this country and those engaged in the manufacture of implements of archery.

For some time there was no material alteration in the laws affecting gaming; but Charles II. desiring to prevent his subjects from becoming 'lewd and dissolute,' an act was passed (16 Car. II. chap. 7) to put down 'deceitful, disorderly, and excessive gaming.' The statute enacted that all persons winning by fraud over certain games and amusements therein specified were to forfeit treble the value of their winnings; that every one losing more than £100 on credit at the games before mentioned was to be discharged from the obligation to pay it; that all securities given for the debt were to be void; and that the winner was to forfeit treble the sum he won in excess of £100. This act of Charles II.'s is said to have been passed in consequence of the vast sums of money won and lost over a match on the turf in which two horses belonging to Mr Tregonwell Frampton and Sir Charles Strickland respectively were the competitors. Before the match came off Frampton's trainer meeting Hesletine, who had charge of Sir C. Strickland's horse, proposed to run a private trial, and at Sir Charles's directions Hesletine assented. Each jockey at the instigation of his master carried 7 lb. more than the specified weight under the idea that he had stolen a march on his opponent. Frampton's horse won the trial after a close race, and his party argued that as he won with the worst of the weights he would achieve an easy victory at even weights. The other side argued that, as their horse was beaten so little when handicapped with an extra 7 lb., he would turn the tables in the race, which, however, ended as the trial had done. So much money changed hands that, as already mentioned, the above act was passed. Passing over for the present the statutes aimed at unlawful games, it is sufficient to notice that by the first licensing act (25 Geo. II. chap. 36) gaming-houses are forbidden; but during the long reign of George III. the government does not appear to have troubled itself much about gaming and gamesters, and we may pass on to the 8 and 9 Vict. chap. 109, the 18th section of which renders void all contracts by way of gaming and wagering. The 16th and 17th Vict. put down betting-houses; and the 31st and 32d Vict. chap. 52 (the Vagrant Act) enacts that every person betting, wagering, or gaming in any open or public place with any table or instrument of gaming shall be deemed a rogue and vagabond, and, upon conviction, shall be punished as the act directs. It was under this act that the proprietors of the 'Pari-mutuel' were punished (see BETTING). In spite of the statutes forbiddir [illegible] ey have been carried on, and [illegible] besides several other cases, th [illegible] upon the Field Club, in Park Place, St James's, and another in Maiden Lane, Strand, the proprietors of which were fined £500 each, substantial penalties being also inflicted upon some of the officials.

It has been mentioned above that the statute of Henry VIII. made certain games illegal; and so long ago as the time of Edward IV. certain other games, like 'Holy Bowls,' were unlawful. In 1618, however, James I. made a declaration that the dancing of men and women, leaping, May games, and some other forms of amusement should be permitted, and Charles I. allowed feasts of dedications of churches, called wakes, to be indulged in; but the 18th Geo. II. chap. 34 put a stop to Roulet, or Roly-poly, a game which could have no connection with modern *roulette*, because the act speaks of Roulet 'or any other game with cards or dice.' It will be noticed that the statute passed in the time of Henry VIII. was not repealed at the time Queen Victoria came to the throne, and it was not until the year 1845 that bowls, quoits, tennis, and many other games of skill could legally be played in any public alley or ground. In 1845, however, it appears to have struck the ruling powers that it was a little incongruous to retain in the statute-book an act which both prohibited games of skill, and ordered people to shoot with bows and arrows, so in that year the 8th and 9th Vict. chap. 109 was passed, and a great deal of the act of Henry VIII. was repealed; and, to sum up, it may be pointed out that racing of all kinds, what are known as athletic sports, all games like cricket, croquet, quoits, &c., all of what are known as 'parlour pastimes,' and most games at cards are now legal. The exceptions are Ace of Hearts, Bassett, Dice (except Backgammon), Hazard, Pharaoh (or Faro), Passage, Roly-poly. It will be observed that neither playing cards for money nor betting are illegal *per se;* they only become so when indulged in under certain conditions. There is nothing unlawful in playing cards in a private house, or whist in a club; but to frequent a gaming-house is not allowed. Again, a man does not break the law because he makes a bet on credit in his house, on a racecourse, or at Tattersall's if he is taken to be a member; but should he stake his money and make his bet at the bar of a public-house or on the street he renders himself liable to be proceeded against.

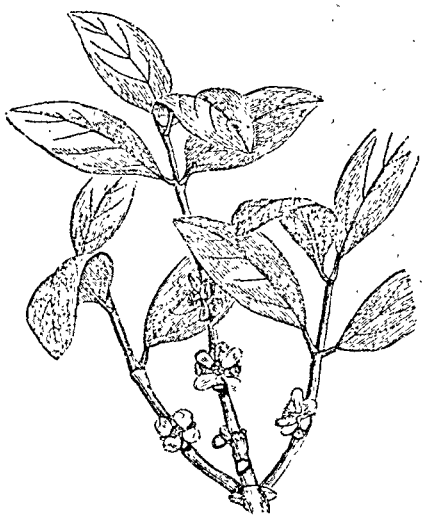
Lotteries, which are first heard of in England in 1569, were for some time legal, and at last so many private and cheating ones became mixed up with the more honourable affairs that legislation became necessary, and the 10th and 11th William III. chap. 17 was passed for the purpose of suppressing them by declaring them public nuisances; though there was still a loophole, for lotteries might be carried on 'under colour of patents or grants under the great seal.' This act, however, did little or nothing to check the evil, nor do subsequent enactments appear to have been more efficacious. State lotteries were altogether put an end to in 1826, from which year we hear very little of lotteries, as the laws against them are now strictly enforced. Raffles and sweeps are illegal, being nothing more than lotteries; yet every club

has its Derby sweep; and when Convocation met in the summer of 1889, and denounced the tendency of all classes towards indulging in betting and gaming, one or two of the speakers spoke in extenuation of lotteries and raffles at fancy fairs organised for charitable or religious objects. Art unions are specially exempted from the operation of the statutes against lotteries by the 9th and 10th Vict. chap. 48, which declares that voluntary associations for acquiring works of art which are afterwards distributed by lot are to be deemed legal after a royal charter has been obtained. Gambling which takes the form of speculating in stocks and shares has long been common, but at present a certain number of outside brokers—men, that is to say, who are not members of the Stock Exchange—are offering every facility to those desirous of indulging in the hazardous pastime. By staking with the broker one per cent. of the amount it is determined to nominally expend, the investor can give his orders. Thus, in the words of the advertisements, £5 (called 'cover') commands £500 of stock. Should the stock fall sufficiently to exhaust the cover, the transaction is at an end; the investor loses his cover, which goes into the pocket of the broker. If the stock rises in the market the investor can claim the difference between its present value and the price at which he bought, or nominally bought, for no stock changes hands in these transactions. No brokerage is charged, and, as palatial offices are occupied, it would appear that a very great majority of speculators lose their money. This system when analysed is neither more nor less than betting upon the rise and fall, the broker being to all intents and purposes a bookmaker.

In the United States, keeping a gambling-house is indictable at common law as injurious to morals; and most states and territories have passed laws against gambling, in some of them severe and stringent. Yet till 1880 gambling was exceedingly common and open throughout the United States; prosecutions were few and fines often merely nominal; and it was left to societies for the suppression of vice and cognate institutions, especially in New York, to stir up the authorities to put the laws in force. In 1881–84 prosecutions and convictions were very numerous; in 1885 almost all the chief cities in the Union followed with success the example of New York in putting down gambling as far as possible.

See BETTING, MONACO, BADEN-BADEN, and articles on the various games; also Frederick Brandt, *Games, Gaming, and Gamester's Law* (new ed. 1873); an article in the *Quarterly* for January 1889; and a bibliography of books on gambling in *Notes and Queries* (1889).

Gamboge, or CAMBOGE, a gum-resin, used in medicine and the arts, the produce chiefly of *Garcinia Morella* (*Gambogia gutta* or *Hebradendron gambogioides*), a tree of the order Guttiferæ (sub-order Clusiaceæ), a native of Cambodia (hence the name), Ceylon, Siam, &c. The gamboge-tree attains a height of 40 feet, has smooth oval leaves, small polygamous flowers, and clusters of sweet and edible fruits. When the bark of the tree is wounded the gamboge exudes as a thick, viscid, yellow juice, which hardens by exposure to the air. It is generally collected in a joint of bamboo, and a single tree will yield sufficient to fill three joints 20 inches in length and 1½ inch in diameter. From this cause it is found in commerce in the form of sticks or cylinders having the markings of the bamboo on the outside. When of good quality it is of a rich, orange-brown tint, and should not show a rough granular surface when broken. Since yellow is a colour sacred to Buddha, gamboge is in much request in Singhalese temples, alike for vestments and decorations. The finest gamboge comes from Siam.—*American gamboge*, which is very similar, and is used for the same purposes, is obtained from *Vismia guianensis*, and other species, shrubs of the order Hypericinæ. Gamboge occurs in commerce



Gamboge (*Garcinia Morella*).

in three forms: (1) in *rolls* or *solid cylinders;* (2) in *pipes* or *hollow cylinders;* and (3) in *cakes* or *amorphous masses.* The first two kinds are the purest. Good gamboge contains about 70 per cent. of resin and 20 per cent. of gum, the remainder being made up of woody fibre, fecula, and moisture. Medicinally it acts as a violent purgative, seldom administered alone. It is employed in water-colour painting, in the staining of wood, and in the formation of a golden lacquer for brass. It can be readily bruised, forming a brilliant yellow, slightly inodorous powder, and possesses a disagreeable acrid taste.

Gambrinus, a mythical king of Flanders, to whom is ascribed the invention of beer. His figure is familiar in German beer-cellars, often seated astride a cask, a foaming tankard in his hand.

Game-laws. Since primeval days man has been a carnivorous animal, and has depended for his sustenance largely upon the flesh of the beasts of the field. At first, doubtless, the only thought was of the capture and destruction of animals whose flesh was agreeable to the taste, not of their preservation and protection for future use. But it is probable that at a very early age domestication was resorted to in order to meet the scarcity caused by the depletion of the forests and the increased wariness of the animals. There are, however, many animals which, though suitable for food, cannot readily be domesticated, and these still remained the objects of the chase in their natural wild condition. Doubtless for a time these latter were still mercilessly hunted down, but gradually the necessity came to be recognised of husbanding the stock even of wild animals against the future. The analogy of the animal kingdom suggests that the pleasures of the chase were just as keen amongst the nomad tribes in the primeval forests as amongst modern British sportsmen; but the primary object then was not the enjoyment of sport, but the collection of a supply of food, and the value of the wild animals was mainly an economic one. But gradually, as civilisation advanced, as cultivation increased, and other sources of food-supply were multiplied, the value of wild animals as food diminished, and protection came to be accorded to them rather as objects of sport than

as a valuable food-provision. This condition had already been reached in England with regard to birds and quadrupeds when the Forest Laws were first promulgated, but the economic as superior to the sporting value of fresh-water fish long held its ground, and indeed still does so to a certain extent in the case of some of the larger rivers. Notwithstanding, however, the small value of game as an article of food in proportion to its value as an object of sport, there is still a utilitarian instinct in the pursuit of many kinds of game; the edibility of the animal is a condition of the enjoyment of sport; nothing grieves a sportsman more than to lose an animal he has killed; and no sportsman would go out to shoot old rooks or blackbirds, although these would supply just as difficult shooting as partridges and pheasants.

By the common law, both of England and of Scotland, following that of Rome, wild animals in a state of nature are common to mankind, and are not proper subjects of private ownership. But at an early stage it was recognised that a free right of hunting was incompatible with the preservation of game in such numbers as to afford ample sport to the monarch and the nobles. Accordingly a series of laws known as the Forest Laws (q.v.) were enacted, whereby certain districts of country were set apart for sport to the sovereign and his donees; and effective provision was made to reserve the exclusive right of pursuing game within the protected areas. But the increase of population and the enclosure of large parts of the country rendered protection necessary for the areas outside of the royal forests if the game was not to be totally extirpated, and the result has been a series of enactments known as the Game-laws.

'Game' includes hares, pheasants, partridges, grouse, black-game, ptarmigan, and bustards. But, in addition, there are a number of animals to which one or other of the game-statutes extends protection. These are rabbits, deer, roe, woodcock, snipe, quail, landrails, and wild duck.

Although there is no private property in wild animals, it is now fixed partly by statute, partly by consuetudinary law as interpreted by the decisions of the courts, that the right to pursue or take game is a private privilege. In the absence of express stipulation this privilege belongs in England to the occupier, in Scotland to the owner of the soil. It has sometimes been represented that, although a wild animal is not private property, the moment it is taken or slain it becomes the property of the person on whose land it is taken or slain. This is not strictly accurate, for if it were so then the poacher who picks up the partridge he has shot would be guilty of theft, which in the present state of the law he certainly is not. On the other hand, there is no doubt that the occupier or owner of the soil is entitled to recover the game from the poacher. The law, therefore, would seem to be most accurately expressed by the statement that the occupier or owner of the soil has a right to claim any game taken or slain upon his land.

The statutory provisions with reference to game are of four kinds—viz. (1) laws for the punishment of poaching; (2) close time provisions for the protection of game during certain seasons of the year; (3) provisions to enable farmers to protect their crops against the ravages of ground-game; (4) revenue and license laws imposing government duties upon the exercise of a right to take or to deal in game.

(1) *Poaching.*—The most important of the acts at present in force against poaching are the Day Poaching Act, 1831 (Scotland, 1832); the Night Poaching Acts, 1828 and 1844; and the Poaching Prevention Act, 1862. These statutes impose penalties for trespass by night or by day in pursuit of game, and for the illegal possession of game; and contain stringent provisions for the detection and punishment of offenders. Night-poaching is treated as a much more serious offence than day-poaching, the reason being that night-poaching, especially by large bands, is apt to lead to acts of serious violence.

(2) *Close Time.*—This is regulated in England by the Day Trespass Act, 1831, and in Scotland by the Preservation of Game Act, 1772. The close time in England is, for partridges, from 1st February to 1st September; for pheasants, from 1st February to 1st October; for black-game, from 10th December to 20th August (1st September in Somerset, Devon, and the New Forest); for grouse, from 10th December to 12th August; and for bustards, from 1st March to 1st September. The seasons in Scotland are the same, except that bustards are not mentioned in the act. By the Day Trespass Act (adopted for Scotland by the Game Certificates Act, 1860) it is also made illegal to deal in game more than ten days after the commencement of close time. It was recently held that this does not apply to game imported from abroad.

(3) *Protection of Crops.*—By the Ground Game Act of 1880 an inalienable right to destroy hares and rabbits found upon his land is given to the occupier. In order to minimise the interference with legitimate sport, it is provided that steel traps shall not be used, except in rabbit holes; that the occupier shall not be entitled to delegate the right to shoot to any person other than one member of his household, specially authorised by him in writing; and that the occupier of moorlands shall be entitled to take hares only between 11th December and 31st March.

(4) *Revenue and License Laws.*—The different duties and licenses in connection with taking and the dealing in game are embodied in a series of revenue statutes, which it is unnecessary to enumerate. A game-license for the whole year costs £3; but a license may be taken for half a year to 1st November, or for half a year thereafter at £2; or a license may be taken for a period of fourteen continuous days at £1. A gamekeeper's license costs £2. Dealers in game must annually obtain a license from the justices, upon production of which and payment of £2 of duty they obtain an Inland Revenue license to deal in game.

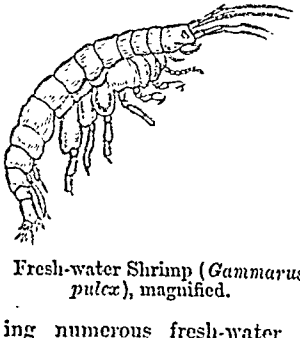
Strong exception is taken to the game-laws by many. It is urged that the provisions for the detection of poachers are harsh and inquisitorial, and there can be no doubt that the difficulty of detecting this offence (arising mainly from the impossibility of identifying the articles taken) has led to the enactment of certain provisions of a very stringent character. Although, however, the provisions are harsh on their face, it may be doubted if it has often happened that any person who had come properly in possession of game, and was able to give an honest account of it, has been subjected to serious inconvenience by the operation of these laws. A much more formidable objection is that the laws are out of harmony with the general sense of a large section of the community; that in the eyes of many respectable persons and of most poachers poaching is no crime; and that many men have by the operation of these statutes been made criminals who would scorn to stoop to any act of ordinary dishonesty. There is force in this objection, for there can be no doubt that, whatever be the explanation, poaching is looked upon by many in quite a different light from any other offence. Prison governors and chaplains tell that they never find a poacher penitent or willing to admit that he has done wrong. The community of the right to game, either as a primitive tradition or as a legal theory handed down from the Roman

law, prevails singularly enough in the popular mind contrary to the constant practice of centuries.

The game-laws are, on the other hand, defended on the ground of vested proprietary interest, to which great commercial value now attaches, and as affording protection against trespass, which would lessen the agricultural value and the amenity of property. But the strongest plea in favour of the laws affording protection to game is that without such protection game would soon cease to exist. In an enclosed and thickly-settled country, amidst a crowded population devoted to sport, game would soon become extinct if the public enjoyed a free right to pursue it. In Switzerland, where the only protection is a close time, notwithstanding the numerous natural retreats for wild animals, game is all but extinct; indeed, it is considered a good day's sport for a large party if a single hare is killed. Again, the concession to the occupier of an inalienable right to ground-game by the Act of 1880 has already led to the hare becoming virtually extinct in many parts of Great Britain. In the opinion of some, no doubt, the total extirpation of game would be a benefit to the country; but, on the other hand, it is urged that not only does the pursuit of game give zest and variety to rural life, and afford healthful enjoyment in the autumn to a considerable section of the community, many of whom are engaged in sedentary occupations for the greater part of the year, but that it also leads to the diffusion of much wealth throughout the poorer districts of the country, and keeps a great deal of money at home which would otherwise be spent abroad.

In the United States any one is free to capture or kill wild animals, subject to the laws of trespassing; save where, as in several states, laws have been passed protecting game during certain seasons, so as to prevent its extirpation.

Perhaps the most feasible suggestion which has yet been made for a reform of the game-laws without withdrawing protection from game is that all the statutes against poaching should be repealed, and a simple provision substituted whereby game should be declared to be the property of the person on whose lands it is found. The effect of this would be to render the taking of game theft, and trespass in pursuit of game an attempt to steal. It is urged in favour of this change that it would simplify the law, remove many harsh and anomalous provisions from the statute-book, and tend to disabuse the popular mind of that theory of the common right to take game which creates disaffection with restraining law. In an unenclosed and sparsely-peopled country wild animals roam at freedom and care for themselves, and they are not therefore appropriate subjects of private ownership. But in an enclosed, highly-cultivated, and thickly-peopled country, game is just as much dependent for its existence as are flocks and herds upon the protection and care of the owners or occupiers of the soil, and may therefore, it is said, appropriately be made the subject of private property of those who maintain it. See Alex. Porter, *The Gamekeeper's Manual* (2d ed. Edin. 1889).



Fresh-water Shrimp (*Gammarus pulex*), magnified.

Gaming. See GAMBLING.

Gam'marus, a genus of Amphipod Crustaceans, including numerous fresh-water and marine species. One species (*Gammarus pulex*), sometimes called the 'fresh-water shrimp,' is extremely common in quickly-flowing brooks. It is a tiny creature, about half an inch long, but so abundant that few can have missed seeing it. It generally keeps near the bottom, swims on its side, with a kind of jerking motion, and feeds on dead fishes, &c. In quiet water *G. fluviatilis* is common, and *G. locusta* is very abundant among seaweeds along all European coasts. Blind species of the allied genus Niphargus are found in many caves and wells.

Gamrun. See GOMBROON.

Gamut, a name for the musical scale—see MUSIC, SCALE (MUSICAL). Guido of Arezzo, in the 11th century, marked the last of the series of notes in his musical notation with a *g* or the Greek letter γ (*gamma*), the name of which came to be used for the whole scale—often in a French form *gamme*. *Gamut* is compounded of this word and *ut*, the beginning of a Latin hymn used in singing the scale. See SOLFEGGIO.

Gand. See GHENT.

Gandak (the *Great Gandak;* the Little Gandak being an unimportant tributary of the Gogra), a river of India, rises in the Nepal Himalayas, in 30° 56′ N. lat. and 79° 7′ E. long., flows south-west to British territory, and then south-east, forming for some distance the boundary between the North-west Provinces and Bengal, and enters the Ganges opposite Patna. Its banks rise above the level of the plains it passes through, and inundations are frequent.

Gandamak, a village of Afghanistan, between Cabul and Peshawar, where, during the retreat from Kabul in 1842, the last remnant of the British force was massacred, only one man making his escape. Here also a treaty was signed with Yakub Khan in 1879. See AFGHANISTAN.

Gandersheim, a small town of 2507 inhabitants in Brunswick, 30 miles N. of Göttingen by rail. Its famous abbey, dating from 852, continued even after the Reformation to give the title of abbess to the daughters of German princes, and until 1803 was itself a principality.

Gandia, a walled town of Spain, on the Alcoy, 2 miles from the sea, and 47 miles SSE. of Valencia by rail. It contains the old palace of the dukes of Gandia, and has some coast trade. Pop. 7604.

Gando, a kingdom of the western Soudan, lying west of Sokoto (to which it is tributary), and on both sides of the Niger as far south as the mouth of the Benue. The inhabitants are mostly Haussa, but the ruling class are Fulahs; nearly all are Mohammedans. The rains are plentiful, the country is fertile, and the vegetation in many places luxuriant.—GANDO, the capital, lies in a narrow valley, surrounded and commanded by hilly chains; but the chief commercial town is Egga (q.v.).

Gandolfo. See CASTEL GANDOLFO.

Ganesa, the most popular among the Brahmanic gods of the second rank, the special deity of prudence, invoked at the commencement of every enterprise, and with whose name every book begins (*namo Ganeçâya*, 'honour to Ganesa'). He is the son of Siva by Parvati, and the leader of his father's train. He is represented with an elephant's head, riding upon a rat, and his figure is found in almost all temples, and also in houses where he has taken the place of the Vedic Agni as domestic guardian.—GANESA is also the name of the author of a 19th-century commentary to the *Lingapurâna* (Bombay, 1858).

Ganga. See SAND-GROUSE.

Ganges, the great river of northern India, prominent alike in the religion and in the geography

of the East, rises in Gahrwal in 30° 56′ 4″ N. lat. and 79° 6′ 40″ E. long., issuing, under the name of the Bhagirathi, from an ice-cave 8 miles above Gangotri and 13,800 feet above the level of the sea. A few miles below Gangotri it receives the Jahnavi, and 133 miles from its source the Alaknanda, from which point the united stream is known as the Ganges. From Sukhi, where it bursts through the Himalayas, it flows south-west to Hardwar, and from thence, by a tortuous but generally south-east course, to Allahabad, where it is joined by the Jumna. From the sacred tongue of land where the two streams meet the great river rolls on in a wide flood, past the holy city of Benares, and across the plains of Behar, fed by the Son, the Gandak, and the Kusi. It then turns sharply to the southward, and, about 20 miles farther on, begins to throw out the branches which enclose the level delta, at a point 220 miles in a straight line from the Bay of Bengal. The main channel, called the Padma or Padda, runs south-east to Goalanda, where it is met by the main stream of the Brahmaputra, and the vast confluence of waters flows in a broad estuary, the Meghna, into the Bay of Bengal near Noakhali. Between this most easterly and the Hugli, the most westerly mouth, lies the delta, with a multitude of mouths and channels. The Hugli or Hooghly (q.v.) is the great channel of navigation (for map, see CALCUTTA). The delta in its upper angle is very fertile, but in the south, towards the sea, the country is a desolate waste of swamps (see SUNDARBANS), intersected by a network of canals. The Ganges has a total length of 1557 (by the Hugli mouth, 1509) miles; its drainage basin embraces over 390,000 sq. m., lying between the Himalaya and Vindhya ranges, and extending east to the mountains which separate Burma from Bengal. Not one of the other rivers of India so deserves the gratitude and homage of the Hindus. In spite of the shoals and rapids that lie above Allahabad, it is in some sense navigable from the point where it enters the lowlands, near Hardwar; and its stream, which never fails in the hottest summer, distributes fertility throughout its course, and even its inundations spread over the fields a rich top-dressing of alluvial silt. The ruined or decayed cities near its banks, however, bear mute witness to the loss inflicted by the constant changes which take place in the river-bed, altering the whole face of the country, as the river deserts old channels for new. But the Ganges is still one of the most frequented waterways of the world; ocean and coast steamers carry goods to Calcutta, and above this city thousands of native boats are employed, even since the development of railways, in transporting heavy goods in bulk, such as timber and bamboos, stone, grain, and cotton.—The Hindustani name *Gangâ*, 'stream,' is according to Max Müller an instance of early Aryan reduplication, from the verb to go—'go-go.'

The Ganges excels all the great rivers of India in sanctity; from the source down to the sea every foot of 'Mother Gangâ's' course is holy ground, to bathe in her waters will wash away sin, to die and be buried on her banks secures free entry to eternal bliss. Gangotri, Hardwar, Allahabad, Benares, and Sagar Island, the most sacred spots, are visited by thousands of pilgrims every year; the great *kumbh* fair, which is held every twelve years, drew nearly 1,000,000 persons to Allahabad in 1882—and these of all Hindu sects, for in the legend of the Ganges the three supreme deities of the Hindu pantheon have part. The earliest form of the legend occurs in the *Râmâyana*, where Gangâ is described as the daughter of the Himalayas, whom Bhagirathi, a prince of Ayodhya (mod. Oudh), after more than twice 30,000 years' solicitation by his father and grandfather, induces Brahma to cause to descend from heaven, that his ancestors, who had been reduced to ashes by Vishnu, might be sprinkled with the sacred waters, and their souls rise to heaven. The ice-cavern whence the river springs is made the matted hair of the god Siva. The story admits of numerous variations, and the *Vishnu-Purâna*, which assigns the source to the nail of the great toe of Vishnu's left foot, sums up the river's properties in this sentence: 'This sacred stream, heard of, desired, seen, touched, bathed in, or hymned day by day, sanctifies all beings; and those who, even at a distance of a hundred leagues, exclaim "Gangâ, Gangâ," atone for the sins committed during three previous lives.'—Gangâ is also considered as the mother of the god of war, Kârttikeya (q.v.).

The GANGES CANAL, opened in 1854, is an important irrigation work and navigable channel, extending, on the right of the Ganges, from Hardwar to Cawnpore and Etawah. The main canal is 445 miles in length, and is navigable throughout; the branches vary greatly from time to time. The Cawnpore and Etawah terminal lines are now absorbed in the Lower Ganges Canal, which draws its supply from the river at Narora, in the Aligarh district, and maintains a navigable depth as far as the regulating bridges at Gopalpur and Jeyra, where it joins these branches, afterwards falling into the Jumna. The original scheme of the Lower Bengal Canal embraced 555 miles of new trunk lines; in 1873–74 work was commenced on a section of 131 miles. The weir and headworks at Narora include a solid wall, 3800 feet long, with forty-two weir-sluices, founded on huge square blocks. The ultimate cost of the entire Ganges Canal is calculated not to exceed 5¾ millions sterling.

Gangi, a town of Sicily, 18 miles SSE. of Cefalù. Pop. 11,935.

Ganglion. See BRAIN, NERVOUS SYSTEM. In Surgery, the name is given to an encysted tumour on a tendon.

Gangotri, a square temple, about 20 feet high, erected on the right bank of the Ganges (q.v.), which here forms a small bay, about 10,319 feet above the level of the sea. This spot is regarded by pilgrims as the source of the holy stream, here called the Bhagirathi, which, however, rises 8 miles higher up. The water here is peculiarly sacred, but few pilgrims come so far, and the only dwelling-house in the locality is occupied by the officiating Brahmans, by whom flasks of the holy element are sealed for conveyance to the plains.

Gangrene (Gr. *gangraina*, 'a gnawing'), or MORTIFICATION, is the death of a part of the body, whether external or internal. It is most common in the extremities, especially the feet. Its immediate cause is always arrest or impairment of the supply of blood to the affected part. This may be produced in various ways: (1) by direct mechanical injury, or by extreme heat (burn) or cold (Frost-bite, q.v.); (2) by severe septic inflammation, usually following injury, or attacking a wound; (3) by disease of the blood-vessels of the part, in combination perhaps with weak heart action. The second group includes the most dangerous and fatal forms of gangrene: Cancrum Oris (q.v.), phagadæna, and hospital gangrene, now happily much less common than they once were. The third includes gangrene occurring as a result of poisoning by ergot of rye, of diabetes, old age, &c.

The symptoms and appearances attending gangrene vary greatly in different cases. Its onset may be sudden or gradual; it may at once become limited, or it may have a constant tendency to extend; it may be preceded and accompanied by

great pain, or may only be observed in consequence of the local loss of feeling. But in all cases the loss of vitality is accompanied by loss of natural warmth, of sensibility and of motion in the affected part, and by a change in its appearance. It may either become moist and swollen, or dry and shrivelled; and its colour may be either dark purple or greenish, or at least at first pale and waxy. The constitutional symptoms are equally variable: if the part affected be small and not vital, and the gangrene limited, they may be slight and of little importance; otherwise there is generally great depression, with rapid feeble pulse, foul tongue, and other signs of alarming illness.

If the gangrene be limited, a separation takes place gradually between the living and dead parts, and, if the patient survive, the disorganised and lifeless texture is thrown off, and the part heals by Cicatrisation (q.v.) or the formation of a scar, indicating the loss of substance. With regard to treatment, the strength must, generally speaking, be maintained by a nourishing but not too stimulating diet, and the part carefully preserved from external injury and from changes of temperature.

In some forms of gangrene amputation may afford the best or even the only chance of saving the patient's life; in others its results are disastrous, as it is almost certain to lead to fatal extension of the disease. Much care is therefore needed in deciding the question whether surgical interference should be resorted to.

Gangs, AGRICULTURAL, a name specially given to companies of women and boys and girls, brought together for labour in the fen-districts of England, or the low and level tracts which lie south of the Wash. The reclaimed land was mainly cultivated by labourers from the villages, which are numerous on the high ground that borders it. To save expense, the labourers on the reclaimed land here consisted, as much as possible, of women, girls, and boys, working in gangs. An act of 1867 provided that no woman or child was to be employed in the same gang with men or boys, and that no woman or girl was to be employed in any gang under a male gangmaster, unless a woman licensed to act as superintendent was also present with the gang. See FACTORY ACTS.

Gangue (Ger. *Gang*, 'a vein'), the stony matrix in which metallic ores occur. Quartz is the most common gangue, but calc-spar too is very frequent, and barytes or heavy-spar, and fluor-spar are also of common occurrence. Large portions of the gangue are generally worked and submitted to metallurgic processes for the sake of their contents.

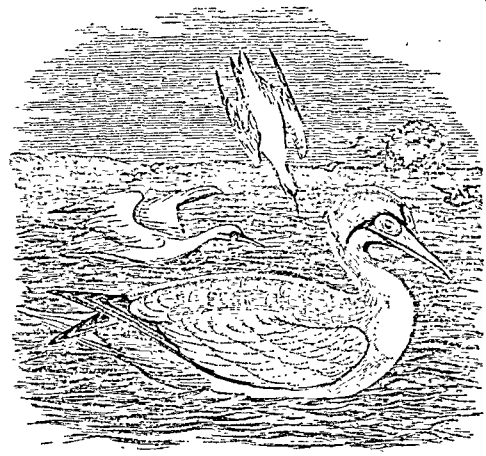
Gan-hwuy, or AN-HUI, an eastern inland province of China, intersected by the Yang-tse-Kiang. See CHINA.

Ganister, or CALLIARD, the name given in the Yorkshire coalfield to a hard, close-grained siliceous stone, which often forms the stratum that underlies a coal-seam. Such hard 'seat-earths' are most common in the lower coal-measures; hence these strata in Yorkshire are often termed the 'Ganister Beds.'

Ganjam, a town of Madras presidency, at the mouth of the Rishikuliya, 18 miles NE. of Berhampur. It was remarkable for its fine buildings, but in 1815, in consequence of an epidemic fever, the civil headquarters were removed to Chicacole. Pop. 5037.—Ganjam district extends along the Bay of Bengal, in the extreme north-east of the Madras presidency. Area, 8311 sq. m; pop. (1881) 1,749,604. The chief town is now Berhampur.

Gannat, a town in the French department of Allier, on the Andelot, 245 miles SSE. of Paris by rail. It has a church dating from the 11th century, and its beer is famous. Pop. 5034.

Gannet (*Sula*), a genus of web-footed birds, in the family Sulidæ, and the order Steganopodes, which also includes pelicans, cormorants, and snake-birds. The head is large, the face and neck naked, the bill straight and strong, longer than the head; the toes (4) are long, and all connected



Adult Gannet or Solan Goose (*Sula bassana*).

by the web. The genus includes about eight species, from temperate and cold seas. They fly, swim, and dive well, but are awkward on land; they feed upon fishes, live socially, and nest in crowds on cliffs and rocky islands. The best-known species of Gannet is the Solan Goose (*S. bassana*), whose popular name is akin to the Icelandic *súlan*, 'a gannet,' while it derives its specific title from the Bass Rock of the Firth of Forth. It is common enough in north Europe from March to October, but migrates southwards—e.g. to Gibraltar, in late autumn. Lundy Isle, the Bass Rock, Ailsa Craig, St Kilda, Suliskerry, and Skelig (Ireland) are celebrated British breeding-places. The entire length of the solan goose is about three feet; its general colour milk-white, the crown and back of the head pale yellow, the quill-feathers of the wings black. The young bird, when newly hatched, has a naked bluish-black skin, but soon becomes covered with a thick white down, so that it resembles a powder-puff, or a mass of cotton. When the true feathers appear they are black, with lines and spots of dull white, so that the plumage of the young is very unlike that of maturity. The bird is long-lived, and takes about four years to come to maturity. It extends its flight to great distances from its rocky head-quarters, pursuing shoals chiefly of such fish as swim near the surface, particularly herring, pilchards, and related forms. The presence of a shoal of pilchards often becomes known to the Cornwall fishermen from the attendant gannets. When feeding, the bird always flies against the wind at an altitude of not more than about 100 feet above the surface of the sea. When it espies a fish it instantaneously stops, and with wings *half* distended, stoops and swiftly cleaves the air. When within a yard or two of the surface, and just as it makes the plunge, the wings are clapped close to its sides. Thus the bird enters the water like a bolt. The nests on the rocks are roughly built of seaweeds and marine grasses, and are huddled together on the available ledges and nooks. The single egg has a chalky white colour, and the surface of the shell is rather rough. During incubation

the goose will often allow itself to be touched with a stick without rising from the nest. The number of gannets that annually visit the Bass Rock in the Firth of Forth is estimated at from sixteen to twenty thousand. The young are killed by cliffmen who are lowered down the rock by a rope; they are valued for the sake of their down, flesh, and oil, which bring a profit to the person who rents the rock. On and around the Bass gannets are seen in prodigious numbers, the air around the rock being filled with them, like bees around a hive, and the rock itself whitened by them and their accumulated excrements. The deafening noise of the harsh cries they utter when they are excited or disturbed adds to the impressiveness of their snowflake-like numbers. The flesh is rank and oily; but that of the young, baked, is eaten to a considerable extent in many places, and is even reckoned a delicacy. The eggs are considered by many connoisseurs to be a decided delicacy. They are boiled for twenty minutes, and eaten cold, with vinegar, salt, and pepper. *S. variegata*, extremely abundant in some parts of the southern hemisphere, is said to be the chief producer of guano; and *S. piscator* is the well-known phlegmatic booby.

Ganoids, an order of fishes once very large, but now decadent, being represented by only seven living genera. These are (1) predominantly cartilaginous forms—Acipenser (sturgeon), Scaphirhynchus, Spatularia (or Polyodon), and (2) bony Ganoids—Polypterus, Calamoichthys, Lepidosteus (bony pike), and Amia. On the other hand, the majority of fossil fish in palæozoic times are Ganoids—e.g. Pterichthys, Coccosteus, Cephalaspis, Pteraspis, Rhizodus. The general characters are noted under FISHES.

Gantang Pass, in 31° 38′ N. lat. and 78° 47′ E. long., leads eastward from Kunawar, in Bashahr, into the Chinese territory. Its height is 18,295 feet above the sea, and it is overhung by a peak of its own name, nearly 3000 feet loftier. The place is unspeakably desolate and rugged, and, being devoid of fuel, it is but little frequented.

Gantlet. See GAUNTLET.

Ganymede, the cup-bearer of Zeus, was, according to Homer, the son of King Tros and the nymph Callirrhoë; or, according to others, of Laomedon, Ilus, or Erichthonius. The most beautiful of mortals, he attracted the notice of the king of the gods, who determined to make him his cup-bearer in succession to Hebe, and accordingly despatched his eagle to carry him off to heaven. The Greeks believed that Zeus gave Tros a pair of divine horses as a compensation for his loss, and comforted him at the same time by informing him that Ganymede had become immortal and free from all earthly ills. At a later period he was identified with the divinity who presided over the sources of the Nile. The Greek astronomers likewise placed him among the stars, under the name of Aquarius ('the water-bearer'), in allusion to his celestial function. Ganymede was a favourite subject of ancient art, and in modern time has prompted the genius of Carstens and Thorwaldsen.

Gaol. See PRISON.

Gaol Delivery, COMMISSION OF, is one of the commissions issued to judges of assize and judges of the Central Criminal Court in England. See ASSIZE.

Gap, the mountain capital of the French department of Hautes Alpes, is pleasantly situated on the Luye, 2424 feet above sea-level, among vine-clad slopes, 47 miles SE. of Grenoble, by a branch line. It has a cathedral (rebuilt since 1866), and some manufactures of silk and cotton fabrics and hats. Pop. (1886) 9345. Gap, the ancient *Vapincum*, was formerly a fortress of some importance, and gave the title of Gapençois to the surrounding district of Dauphiné.

Gapes, a disease of fowls and other birds, due to the presence of threadworms or Nematodes (*Syngamus trachealis*) in the windpipe. As a large number (twenty) may be present, the worms cause inflammation, suffocation, and death. The worms breed in the trachea, embryos are coughed up, and, if swallowed by the same or other birds, pass from stomach to air-sacs, lungs, and eventually to the windpipe. As to the external life of the embryo there are two theories: Mégnin, for instance, says that they get into the food when coughed up, and thus pass very directly from fowl to fowl; while H. D. Walker has given strong reasons for suspecting that they pass first into the earth, then into earthworms, and thence into birds. For treatment, see POULTRY (DISEASES OF). See also NEMATODES, PARASITISM.

Garabit, a point on the railway from Marvejols (Lozère) to Neussargues, about 10 miles S. of St Flour, in the French department of Cantal, where the line crosses a gorge through which the waters of the Truyère run, 401 feet below the rails. The viaduct, the work of M. Eiffel, is built partly of girders and partly of masonry, and has a total length of 1852 feet 6 inches. Where it crosses the river it is supported by an arch, with a span of no less than 541 feet 4 inches. See *Engineering* (1885), and Eiffel, *Le Viaduc de Garabit* (1889).

Garamantes. See FEZZAN.

Garancine, a dyestuff derived from Madder (q.v.). See DYEING, Vol. IV. page 136.

Garay, JÁNOS, Hungarian poet, born at Szegszárd in 1812, lived mostly at Pesth, where he obtained in 1847 a post in the university library, and died 15th November 1853. His study of the masterpieces of German literature and of Vörösmarty bore fruit in numerous dramas, chiefly of historical character: *Csáb* (1835), *Arbocz* (1837), and *Országh Ilona* (1837), as well as long poems, as *Csatar*, an epic (1834), and *Szent Laszlo*, a historical poem (1850). In 1847 he published *Arpádok*, a poetical version of the historical legends of Hungary, and next year *Balatoni Kagylók*, a collection of lyrics. A complete edition of his poems was published by Franz Ney (5 vols. Pesth, 1854), a selection in German by Kértbeny (2d ed. Vienna, 1857), and a Life by Ferenczy (Pesth, 1883).

Garaye, LA, a ruined château in Brittany, 2 miles from Dinan. Its last owners, Claude Toussaint and his countess, in the first half of the 18th century converted it into an hospital, which forms the theme of the Hon. Mrs Norton's poem, 'The Lady of La Garaye' (1862).

Garb, or GARBE (Fr. *gerbe*), a sheaf of any kind of grain. A garb is frequently used in heraldry.

Garcia, MANUEL, vocalist and composer, was born at Seville, in Spain, 22d January 1775. After acquiring a considerable reputation as a tenor singer in Cadiz and Madrid, in 1808 he obtained great success at the Italian Opera in Paris, and afterwards proceeded to Italy, where he was received with equal favour. From 1816 to 1824 he was constantly engaged as a singer, either in Paris or London. In 1825, with a select operatic company, composed in part of members of his own family, he crossed the Atlantic, and visited New York and Mexico. On the road between Mexico and Vera Cruz he was robbed of all his money; and after his return to Paris he was compelled to open a class for singing, as his voice had become greatly impaired by age and fatigue. Many of Garcia's

pupils reached a high degree of excellence, but none equalled his eldest daughter Maria, afterwards Madame Malibran (q.v.). He was less successful as a composer, although several of his works, such as *Il Califo di Bagdad*, were much admired. Garcia died at Paris, 10th June 1832.—PAULINE VIARDOT-GARCIA, his second daughter, born at Paris in 1821, acquired a considerable reputation as a mezzo-soprano singer, and also composed several operettas and songs.

Garcilaso, a Spanish historian, surnamed the *Inca*, from his mother, a princess of the royal race of the Incas, was son of Garcilaso de la Vega, one of the conquerors of Peru, and was born at Cuzco in 1540. At the age of twenty he proceeded to Spain, and lived the rest of his life at Cordova, where he died in 1616. His first work was *La Florida del Ynca* (1605), an account of the conquest of that country by Fernando de Soto. In 1609 appeared the first, and eight years later the second part of his great work on the history of Peru, entitled *Commentarios Reales, que tratan del régen de los Incas reyes, que fueron del Perú.* Garcilaso's *Royal Commentaries was translated into English* by Sir Paul Rycaut (1688), and by C. R. Markham for the Hakluyt Society (1869).

Garcilaso de la Vega, a great Spanish poet, was born at Toledo about 1503. He early adopted the profession of arms, and gained a distinguished reputation for bravery in the wars carried on by the Emperor Charles V. against the French and Turks, but was mortally wounded while storming a castle near Fréjus, in the south of France, and died at Nice, November 1536, in the thirty-third year of his age. Though prematurely cut off, he lived long enough to win immortality; and, though he wrote little, he revolutionised the national poetic taste of his countrymen. For the short metre of the older romances and redondillas he substituted the hendecasyllabic verse of the Italians. Strangely enough, his poems contain not a trace of military ardour, but are inspired by a tender sweetness and melancholy which appear to have deeply affected his countrymen. 'His sonnets,' says Ticknor, 'were heard everywhere; his eclogues were acted like popular dramas. The greatest geniuses of his nation express for him a reverence they show to none of his predecessors. Lope de Vega imitates him in every possible way; Cervantes praises him more than he does any other poet, and cites him oftener. And thus Garcilaso de la Vega has come down to us enjoying a general admiration, such as is hardly given to any other Spanish poet, and to none that lived before his time.' The best of the numerous editions of his poems is that by Azagra (Madrid, 1765). They have been translated into English by Wiffen (1823).

Garcinia. See MANGOSTEEN.

Gard, a department in the south of France, on the Mediterranean, and bounded on the E. by the river Rhone, with an area of 2245 sq. m., one-third of which is arable. It is watered mainly by the Rhone, and by its tributaries the Gard—from which the department has its name—and the Cèze. Of its surface the north-west is occupied by a branch of the Cevennes, the remainder slopes toward the Rhone and the Mediterranean, the coast being lined by extensive and unhealthy marshes; the climate here is unwholesome, and in summer the heat reaches 104° F. The soil is unequal, the best land occurring in the river-valleys. The famous grapes have almost disappeared before the ravages of the phylloxera; less and less land yearly is retained for vineyards; and the production of wine has sunk to less than a fourth of what it was before 1875. The rearing of silkworms is widely engaged in, and the cultivation of olives and chestnuts is of value. The minerals include coal, iron, argentiferous lead, antimony, marble, and salt; and the department's iron and steel works are important. The department is divided into the four arrondissements of Alais, Nîmes, Uzès, and Vigan; the chief town is Nîmes. Pop. (1861) 422,107; (1881) 415,629; (1886) 417,099.

Garda, LAGO DI (the *Lacus Benacus* of the Romans), the largest lake of Italy, lies between Lombardy and Venetia, its northern end extending into the Austrian Tyrol. Situated 226 feet above sea-level, it has an area of 115 sq. m., a greatest length of 35 miles, a breadth of 2 to 11 miles, and a maximum depth of 967 feet. Its chief tributaries are the Sarca and Ponale, and it is drained by the Mincio, a tributary of the Po. The scenery is grand: at the north end alpine spurs border the lake on both sides, and descend steeply to its shores, but contain within themselves also many beautiful and fertile valleys; farther to the south the country sinks by gentle slopes to the level of the plain of Lombardy. Along the western shore the mulberry, fig, grape, myrtle, and citron are grown in the sheltered gardens, many of them terraced; olives flourish most on the opposite bank. The clear waters of the lake abound in fish of various kinds. Its surface is studded with many islands, and steamers ply between the principal points. The mild climate in the district of the lake, and the beauty of its vicinity, have caused its shores to be lined with beautiful villas; and the district between Garguano and Salo, called by the people La Riviera, passes for the warmest point in northern Italy. Arco, near the head of the lake, is growing in favour as a winter-resort. The neck of land jutting out for 2 miles from the southern shore, and now called Sermione, is the *Sirmio* praised by Catullus, who had a country-house here, as the 'darling of peninsulas.'

Gardaia, or GHARDAÏA, the Mozabite capital, in the Algerian Sahara, stands on a conical hill, in an oasis-valley full of date palms, 1740 feet above sea-level, and 82 miles WNW. of Wargla. The town is surrounded by a low, turreted wall, and in 1882 a fort was built by the French, who placed a garrison here. The place is now included in the *territoire militaire*, and appears in the census of 1886 with a population of 26,443.

Gardant, in Heraldry, is said of an animal which is represented full-faced, and looking forward. See PASSANT.

Gardelegen, an old town of Prussian Saxony, on the Milde, 28 miles (53 by rail) NNW. of Magdeburg, with a foundry, manufactures of buttons, &c. Pop. 7258.

Garde Nationale. See NATIONAL GUARD.

Garden City, the Episcopal cathedral town of Long Island, in the barren Hempstead Plains, 19 miles E. of Brooklyn by rail, was laid out as a town of model villas by the New York millionaire, A. T. Stewart, who laid down 27 miles of boulevards, and planted some 50,000 trees. His widow erected here a Gothic cathedral (1877–85), a cruciform building, small, but profuse in detail and ornament, with western spire and circular apse. Close by are the bishop's residence and the cathedral schools, besides other seminaries. Pop. 574.

Gardeners' Garters. See CANARY GRASS.

Gardenia, a genus of Cinchonaceæ, tropical and subtropical trees and shrubs, frequently introduced for their beautiful and fragrant flowers —e.g. *G. florida* and *G. radicans* from Japan, and other species from the Cape, where their hard timber also is esteemed. The fruit of other species is used in dyeing silks yellow. The colouring principle is identical with that of saffron (Crocin). The

Indian *G. arborea* and *gummifera* yield a yellow resin. The name was given by Linnæus in honour of Dr Alexander Garden, born in Scotland in 1830, who practised medicine in South Carolina, became eminent as a botanist, and died in London in 1791.

Gardening, or HORTICULTURE, the ordering and management of a garden, differs from agriculture chiefly as being conducted on a smaller scale and with more minuteness, while concerned with a greater variety of subjects. As in a house, so in a garden (though the line is seldom quite distinct), part is devoted to comfort and enjoyment, and the other part to provision for them; the former part forms the pleasure-ground, and the latter the kitchen-garden. Leaving vinery, pinery, hothouse, greenhouse, &c., as special matters, we glance briefly at our subject in this distribution.

The pleasure-grounds comprise the lawns, the walks or drives, the flower-beds, ornamental trees and shrubbery, and, in large places, terraces, lakes and fountains, statues, rockwork, fernery, and the like.

The kitchen-garden, being designed for the supply of fruit and vegetables, contains the trees, plants, and bushes needful for that purpose, with proper walks for access to them, and appliances, such as hotbeds, pots, and frames, &c., for advancing or improving them; and is often enclosed either partly or wholly by a wall, which shelters and promotes the growth.

(1) The *pleasure-ground* (or flower-garden), however small, has almost always one grass-plot, which is called a lawn, though it may be but a little one. Whether space be scant or ample, the *lawn* is the leading feature and the most pleasant part of the pleasure-ground, and it should be well kept first of all. This can be done at small expense by frequent use of the 'lawn-mower,' which has quite superseded the scythe wherever the slope of the ground permits it. It is, however, of prime importance that the grass should be of the proper kind, and not of rank or wiry growth. Hence the most perfect lawns are made by the sowing of carefully selected seed rather than by laying turf, though the latter is the quicker process. In any case, the use of the roller must not be neglected, and during the time of rapid growth the lawn-mower, set for cutting close, should be employed at least twice a week. But it is a mistake to mow very closely during periods of drought. All weeds should be extirpated as soon as they appear, and moss (which is in damp situations the worst of all foes) must be checked at once, or it will soon destroy the herbage.

The *walks* are even more important in many cases than the lawn or lawns, and unless they have been made with skill and care they will always be troublesome. A dry, compact, and even surface, without which no good walk can be, is not secured without depth of substance, proper form, and good drainage. The depth should be at least 12 inches, to secure freedom from weeds and worm-casts, as well as a firm, dry surface. Nine inches of brick-rubbish, clinkers, chalk, burnt earth, or other open and absorbent matter should underlie 3 inches of good binding gravel, and the middle should be rounded well to carry off the rainfall, for which purpose also there must be drain-traps on either side conducting into cesspools, or other receptacles of ample capacity. The position and frequency of these drain-traps must depend upon the slope of the ground, the average rainfall of the place, &c. It is false economy to stint the width of walk, even when carriages are not required. No walk should be less than 5 feet in width, unless there is some special reason, and 6 or 7 feet should be afforded even to a side-walk of any importance. It is a common practice to scatter salt or other poisonous matter on walks to destroy the weeds or worms, but the remedy is generally worse than the disease. With proper care a walk can be kept clean, and looks more cheerful without these applications.

As to the flower-beds, their arrangement and composition should depend upon the taste of the owner, which is too often set aside in favour of the passing fashion. A common mistake in small gardens is to cut up the grass into intricate patterns with a number of fantastic flower-beds, and to lay them out in colours, like a window of stained glass. Or even the same bed is planted with stripes and sweeps of every tint produced by bloom and foliage, and the stiff artificial effect is called a triumph of carpet-bedding. Happily this taste is growing obsolete, and a more natural style is in vogue again. But the opposite extreme must be avoided, that of having flower-beds without flowers. The borders should have at least two bright periods, that of spring-blooming bulbs and tubers, from March to the middle or end of May, and again that of bedding plants, from the latter part of June till the frost of autumn nips them. In the larger flower-beds there are also some perennial plants or shrubs of dwarf habit, such as roses, azaleas, rhododendrons, and the like, which form the back or centre, according to the slope. Whatever the shape may be, every flower-bed should have sufficient slope of soil and definite edging, whether of turf, or tiles, or box, or other dwarf-growing and tidy plants; and the surface should be dressed at least once a year, if the soil cannot otherwise be renewed, with rich material of neat appearance, such as thoroughly rotten manure, decomposed vegetable substance, &c., the darker in colour the better, but light in substance, and not apt to bind. The plants employed for summer bedding (which should be done towards the end of May) have generally been raised under glass in small pots, and their variety is almost endless, new ones being introduced continually. As a general rule those of prostrate or very low habit should be in front, with taller growth towards the centre or back, and a pleasing contrast or change of colour. Most of them will flower for weeks in succession, if well watered and not allowed to seed—for the formation of seed checks the growth at once.

In large pleasure-grounds ornamental trees add much to the beauty of the scene, by graceful form or tint of foliage, and sometimes by brilliance of bloom or berry. As a general rule these should stand far apart, unless there is something unsightly to conceal, and should not be very near the dwelling-house, except where shelter is needful. The choice and arrangement belong rather to the department of landscape-gardening, but none should be planted which have not been proved capable of enduring the coldest winter or the roughest weather they are likely to confront. This caution applies especially to all the race of imported conifers, few of which can withstand a winter of exceptional rigour. Thus in the second half of the 19th century, in 1860, 1867, and 1881, that general favourite the *Abies*, or *Cedrus Deodara*, has been greatly injured by frost, even in the south of England.

The shrubbery also is a pleasant adjunct wherever space is plentiful, affording the coolest walk in summer, and in winter the most sheltered. The shrubs should be mainly evergreen, though a few deciduous may be admitted for the sake of the bloom or variety of colour. But forest-trees must not be allowed to overhang and starve the dwarfer growth.

Other features of the pleasure-grounds, such as terraces, lakes, and fountains, &c., pertaining rather to the domains of the wealthy, will be treated more aptly under the head of LANDSCAPE-GARDENING. But a place without any very great pretensions may have its rockwork and fernery,

which are often combined in some sheltered spot, and offer a pleasant retreat from the glare of the flower-beds or trimness of the lawn. Many good judges pronounce that statues are out of place even in the largest garden, intruding on the sense of repose, and competing for attention with fairer nature. But, if the owner must have them, he should not post them too conspicuously, and should have them as little as possible at enmity with nature.

(2) The *kitchen-garden*, for the supply of fruit and vegetables, is generally kept out of view from the house, either by walls or a fringe of trees or shrubs. This also should have good walks and drainage; but use is more studied than appearance here, so that graceful curves are dispensed with, and the ground is divided conveniently into squares or parallelograms. When the case permits, this garden is enclosed by walls of stone or brick—the latter to be preferred for fruit—and should slope towards the south or south-east, and must not be overhung by trees. There are very good gardens not favoured thus; but the ideal kitchen-garden perhaps should be a square of from one to two acres, facing not the cardinal but the intermediate points, SE., SW., NW., NE. Every wall thus obtains a share of sunshine, the south-east aspect is quite as good as the south, and the south-west not very far inferior, at least in the warmer part of England, while the north-east aspect is much better than due north for Morello cherries or other hardy fruit. Parallel with the walls inside are borders from 12 to 25 feet in width, parted by straight walks at least 6 feet wide from the squares or parallelograms forming the chief area, which are intersected by paths at right angles, with two main walks crossing at the centre of the garden. Very often these inner squares, or quarters, are cropped with vegetables or bush-fruit, while the wall-borders are reserved for strawberries, early lettuce, kidney-potatoes, or other dwarf growth which is advanced by the warmth of the situation. Although the produce of the kitchen-garden may be roughly distinguished as vegetables and fruit, the two are very seldom kept entirely apart, the general practice being to crop the ground with vegetables between the lines of fruit-trees. And it is still more difficult to part the two by any botanical definition. Popular usage must therefore be followed, though even this is sometimes uncertain, the tomato, for instance, being assigned by some to the fruit and by others to the vegetable class.

In common parlance, vegetables are described as plants grown for culinary use. Of some the esculent part is the root; of others, the stem or foliage; of others, the bloom or its receptacle; of others, the seed, whether ripe or unripe, and with or without its capsule. As an instance of each may be given the carrot, celery, cabbage and cauliflower, peas and beans, of which latter the seed is consumed without the pod or with it, according to the variety. The vegetables chiefly used in Britain are as follows, some attempt being made to place them according to their importance, though all households may not concur in this. The potato, the cabbage-tribe (including the hearted cabbage, the colewort, the savoy, the broccoli, and cauliflower, seakale, couve tronchuda, and others), onions and leeks; salad-plants, such as lettuce, endive, radishes, &c.; the leguminous—i.e. peas and beans, of several varieties; the carrot, celery, turnips and parsnips, asparagus, spinach, rhubarb, beet-root, shallots and chives, artichokes (both Jerusalem and globe), cucumbers and marrows, salsify and scorzonera, horse-radish, and culinary herbs of divers kinds. The tomato or love-apple (*Lycopersicum esculentum*) has of late years become so popular, and is considered so wholesome, that it claims a high place in the foregoing list, which is not presented as exhaustive. For all of these plants a soil of medium staple is desirable, for a stiff clay is cold and too retentive of moisture, while a sandy or gravelly land both suffers from drought and affords little nourishment. The soil which gardeners describe as a rich loam is the best of all for their purposes; and if it be 3 or 4 feet in depth, with a substratum of gravel to ensure drainage, it will grow the very best vegetables, without that excess of manure which is apt to increase the size, but to impair the flavour. Space forbids us to do more than cite a few general rules to be observed in the growth of vegetables, and there are plenty of excellent books on the subject.

A heavy soil is much improved by the mixture of light materials, such as sand, ashes, leaf-mould, road-scrapings, or anything that tends to keep the surface open and the mass more permeable. A poor sandy staple, on the other hand, should be made more retentive and tenacious by the addition of clay or heavy loam or manures of a moist and substantial kind. Whatever the soil be, it should be moved deeply at every time of planting, but the subsoil, if very poor, should not be brought up, especially for shallow-rooted plants. All the cabbage-race, and nearly all plants that are grown for their flower or foliage, require strong nurture and plenty of moisture; while many plants cultivated for the sake of the root, especially the potato, are injured by reeking and heavy manures. Even the onion, though it likes a rich bed, should not have a rank one. Watering, if once begun, should be repeated, until there is sufficient rainfall. The use of the hoe between growing plants is most beneficial, and the surface should be kept loose and open. Let nothing run to seed, unless the seed is wanted. It is better to give too much space than too little, and the sequence of crops should be carefully considered, so that like should never follow like, when it can be avoided. If it cannot be avoided, the ground should be deeply turned over, and plenty of fresh nourishment supplied. In planting, let the fibrous roots be spread well, and the soil made firm round the stem or collar. Whether the crop is sown or planted, the drills or rows should be so arranged that the sunshine may pass along rather than across them, and few plants come to perfection under trees even in the brightest summers.

Fruit, which forms an important part of kitchen-garden produce, is ranged in three classes generally, according to its mode of growth, whether on plant, or bush, or tree. Of plant or ground fruit we have chiefly the strawberry and the melon. The latter is rather a subject for cultivation under glass—although in warm spots and fine summers the hardier sorts may succeed in the open; but the strawberry is to be found in almost every kitchen-garden, a universal favourite, and not difficult of culture if the right kinds be selected. A sunny wall-border deeply dug, and then trodden firm, if the soil be light, is the best position for the early kinds. The distance between the plants is governed by the vigour of the growth, but the rows should generally be two feet apart, or even three, when the growth is very strong. The beds should be renewed every second or third year, according to the constitution of the kind. Probably this fine fruit takes its name, not (as is often supposed) from the use of straw to keep it clean, but from the way in which the berries, having but a slender footstalk, are strewn or strawn by their weight upon the ground.

Of bush-fruit the most important are currants, gooseberries, and raspberries, the former two being raised from cuttings, and the last from suckers. Raspberries delight in a rich and heavy soil, and a place where no drought can reach them. The black

currant also rejoices in moisture; but the white and red currants and gooseberries thrive well in lighter places.

Tree-fruit is of many kinds, and grown in divers manners. A broad distinction was made of old betwixt wall-fruit and that of standards, as if the former were far superior both in size and quality. But now it is acknowledged that any fruit which can be ripened thoroughly or brought into proper state for gathering 'in full wind,' as the French express it, will prove of higher flavour and of finer flesh than if it had received the relaxing influence and coddling of a wall. Still, the wall affords much fairer chance of protecting tender bloom from frost, and heavy fruit from winds, as well as of ripening later kinds, which ought not to be culled till October.

Taking wall-fruit first, we find the following chiefly favoured thus: the peach, the nectarine, and apricot, the finer sorts of plums and gages, cherries, pears, sometimes apples of dessert varieties, and also figs and hardy grapes, which ripen in warm seasons and warm places with good management. For stone-fruit the usual mode of training is to spread the branches against the wall in radiations, like those of a fan, removing the breast-wood while quite young, and laying in the bearing wood on one or both sides of the leading branches, and at proper intervals. Very few gardeners understand the education of a wall-tree; and a peach-tree perfectly trained and equally balanced, yet full of vigour, is one of the fairest and rarest sights. Nothing less than loving labour and great skill can bring this to pass; but for ordinary work and good results these points must be attended to—vermin must be nipped in the bud, gross shoots must be removed or reduced, and redundant fruit taken off right early. These rules apply to the pear as well, when trained against a wall, although that fruit is less oppressed by insects, and the tree is usually trained in the horizontal or rectangular form—that is to say, with side-branches issuing at intervals of about a foot from the main stem or leader. Another mode of training, called the 'cordon system,' is now in vogue with the pear, the plum, cherry, and other wall-fruit. This is not by any means a novelty, but rather a revival; and where the walls are high, and many varieties are needed, it is sometimes employed with good effect, though the difficulty is to repress the longing of the tree for ampler foliage. It is a system of strict repression, and the victim requires frequent care; and even at the best we have a triumph of art over nature, instead of with it.

Without the aid of a wall, fine fruit—quite as handsome in some cases, and often of better quality—can be grown in good situations and average seasons with ordinary skill. Trees planted thus for fruiting 'in full wind' are described as either standards, pyramids, or bushes. The first have a single stem free from branches for several feet above the ground—perhaps 6 feet is the average. There the branching begins, and the growth continues according to early treatment, with either an upright leader or open divergence of coequal shoots. This tall growth is mainly used for orchards now, or in gardens for planting alternately with pyramids or bushes. The pyramid—more correctly perhaps it should be termed the conical tree—is formed by allowing the lower shoots to remain, and even encouraging them (when the habit of the sort requires it) by stopping the leader at intervals, so that we have a young tree furnished with tiers of side-shoots from the base upwards in regular succession, yet still possessing a central upright. In the bush the leader has been removed, if there ever was one—for some varieties branch thus by nature; and then we have a spreading growth without any central occupant, as the nut-trees are usually formed in Kent, and the currant and gooseberry everywhere.

Where space is restricted and growth must be compact, the conical form of tree suits well, and offers most temptation to those who love experiments. But when great bulk of fruit is called for, either the 'pyramid' must be allowed to earn its name by magnitude, or the free and tall standard must have its own way, with coercion administered prudently. Many writers, especially nurserymen, have pleasure in proving that the maximum of fruit is to be achieved with the minimum of tree; but nature works otherwise, and if she be not heeded experience will impress the error. Continual lifting and pinching of trees (alternated as such correction is with doses of rank liquor) act upon their systems as feast and fasting might act upon the gardener. To those who have not studied the precepts (rather than the practice) of recent authorities this will appear a truism.

Without controversy, it is enough to say that in this, as is in most other matters, the middle course is the best and safest. Fruit-trees in the open should be planted at fair distance from one another; pyramids of strong sorts 10 feet asunder, and of weakly kinds not less than 8; standard-trees 15 feet apart, to do justice to themselves and allow it for some years to the humbler growth betwixt them. Many must be checked in their lateral spread until they have filled their forms, not densely, but with equable bearing wood; and none should be allowed to sacrifice their future for the sake of present gain. It should also be borne in mind that stone-fruit, if any is thus grown, does not bear the knife as kindly as the pears and apples do. If the plum and cherry must be brought into the form of bush or cone, it can only be done to good effect by nipping the young growth before midsummer, and by very slight winter-pruning. Any amputation of thick branches produces gumming, and maims the tree. To achieve the pear and apple in small compass and with quick increase dwarfing stocks are much employed, the pear being grafted or budded on the quince, and the apple on the *Paradise* or *doucin*. Many varieties thrive well on these, some for many years, and others for a shorter time, according to their liking; and larger and finer coloured fruit is the early result of the union. Nurserymen by experience know what sorts to offer in this form, and what are less complaisant. The espalier also, which may be termed a multiple form of cordon, is frequently found in kitchen-gardens, though not universal as in days gone by. The tree is trained horizontally on stakes, or wires, in tiers proceeding from the central stem, and for heavy fruit this method doubtless offers more stability; but the disadvantages are many, and in common with the *quenouille* (which is a modification of it) the espalier has yielded place to the less exacting pyramid.

For fruit-trees, as for vegetables, a few well-known but often slighted cautions may be offered. Let sufficient space be given; luxuriant growers may sometimes stand alternate with the feebler; let no tree be planted deeply, nay, if the soil be wet and heavy, plant almost upon the surface, banking up and staking well. Remove the coarser tap-roots if there be enough of fibre; prune but slightly, if at all, until fresh growth has started, and then be not too hard with it. Do not clog with rank manure, but let the ground have been well worked before the tree is planted. Give the needful nurture, when the fruit is taxing the resources of the root, either by mulching with fat manure, or presenting it in liquid form. Let not the tree be overcropped: a hundred puny fruits are

not equal in bulk to a score of fine ones, and far less in quality, yet they exhaust the powers of the parent more than the worthy progeny. Be careful as to the time of culling: even the earliest fruit should not be allowed to get dead-ripe on the branch, whereas the winter kinds are often gathered prematurely, especially under the menace of a storm. General pruning should be done in winter, when the trees have filled their spaces, and should be tempered with mercy; but for this directions will be found in our article upon that subject.

Hot-beds in the kitchen-garden are chiefly for promoting and protecting early growth of tender stuff, such as marrows, cucumbers, potatoes, mushrooms, &c. No description, but experience alone and common sense can give the key to the management of this close work. Only it may be said that half the failures which occur are caused by excess of heat, stint of air, and injudicious coddling. See also PLANT-HOUSE.

The gardener, whether he has to study beauty or utility—not that these are discordant powers—must endeavour to move along the broad walk of intelligence, despising nothing because it seems new, still less because it is old; and striving to learn from others all he can, and from himself the whole of it. The multiplicity of art for him is multiplied by the infinitude of nature, and before he is out of his rudiments his time comes to be made perfect.

Among the many treatises upon Gardening, general or special, a few may here be mentioned: Loudon's *Encyclopædia of Gardening* (1878); Loudon's *Encyclopædia of Plants* (Wooster's edition); Lindley's *Vegetable Kingdom;* Lindley's *Botanical Register;* Lindley's *British Fruits;* Vilmorin's *Vegetable Garden;* Sweet's *British Flower-garden* (7 vols.); Robinson's *Flower-garden;* Paul's *Rose-garden;* Hibberd's *Rose-book;* Hibberd's *Amateur* [illegible]'s *Fruit Manual* (5th edition); *Dictionary* (Brown's edition); *Vine-culture;* Thompson's *Gardener's Assistant;* Cassell's *Popular Gardening* (4 vols.); Hemsley's *Hardy Trees and Shrubs;* Smith's *Dictionary of Economic Plants.*

Gardes Suisses. See SWISS GUARDS.

Gardiner, a town and port of Maine, on the Kennebec River, 56 miles NNE. of Portland by rail. Pop. 4439.

Gardiner, COLONEL JAMES, son of Captain Patrick Gardiner, was born at Carriden, in Linlithgowshire, January 11, 1688, and when only fourteen years old obtained a commission in a Scots regiment in the Dutch service. In 1702 he passed into the English army, and in 1706 was severely wounded at the battle of Ramillies. Gardiner fought with great distinction in all the other battles of Marlborough. In 1715 he was made first lieutenant, then captain of dragoons; and in the same year he gave a conspicuous proof of his courage, when, along with eleven other daring fellows (eight of whom were killed), he fired the barricades of the Highlanders at Preston. From an early period Gardiner was noted for his licentiousness; but in the year 1719 a vision of Christ on the cross transformed the brave but wicked soldier into a pious and exemplary Christian. In 1724 he was raised to the rank of major, and in 1726 he married Lady Frances Erskine, daughter of the fourth Earl of Buchan, by whom he had thirteen children, only five of whom survived him. In 1730 he became lieutenant-colonel of dragoons, and in 1743 colonel of the Enniskillens. Deserted by his dragoons at the battle of Prestonpans, fought close to his own house, he put himself at the head of a handful of infantry, and fought till, cut down with a Lochaber axe, he was borne to the manse of Tranent, where he died in a few hours, September 21, 1745. See his Life by Dr Doddridge (1747).

Gardiner, SAMUEL RAWSON, historian, was born at Ropley, in Hampshire, March 4, 1829, and educated at Winchester and at Christ Church, Oxford, taking a first-class in 1851. For some years he filled the chair of Modern History at King's College, London, but resigned it in 1885 to continue his History at Oxford on an All Souls' elective fellowship. In 1882 he was granted a Civil List pension of £150. The period to which he has devoted himself with a more than German patience and thoroughness of study, and a remarkably candid and unbiased openness of mind to the documents and the evidence of the time itself, is that of the first two Stuart kings of England. His work he gave to the world in the following instalments: *The History of England from the Accession of James I. to the Disgrace of Chief-justice Coke* (1863), *Prince Charles and the Spanish Marriage* (1869), *England under the Duke of Buckingham and Charles I.* (1875), *The Personal Government of Charles I.* (1877), and *The Fall of the Monarchy of Charles I.* (vols. i. and ii. 1882). The last was of course intended to extend to the death of the king, but in the first two volumes had only been brought down to 1642, when the whole of the preceding were grouped together and republished (1883-84) in ten volumes, as a continuous history of England from 1603 to 1642. Of the second half of his task, the *History of the Civil War,* he published the first volume in 1886, the second in 1889. Other works are *The Thirty Years' War* (1874) and *The First Two Stuarts and the Puritan Revolution* (1875) in 'Epochs of Modern History,' and *Introduction to the Study of English History* (1881), written in conjunction with Mr J. Bass Mullinger. For the Camden Society he edited the *Fortescue Papers,* the *Hamilton Papers,* the *Parliamentary Debates in 1610,* and *Debates in the House of Commons in 1625.*

Gardiner, STEPHEN, Bishop of Winchester, was born between 1483 and 1490 at Bury St Edmunds —a clothworker's son, say some; others, a natural son of Bishop Woodville of Salisbury. He studied at Trinity Hall, Cambridge, in 1520-21 proceeding doctor of civil and of canon law; and soon after, through the patronage of the Duke of Norfolk, he was introduced to Wolsey, who made him his secretary. In this capacity he won the confidence of Henry VIII., and by him was employed during 1527-33 in promoting at Rome and elsewhere his divorce from Catharine of Aragon. At this time he was known as Dr Stephens. He had become master of his old college in 1525, Archdeacon of Norfolk in 1529, and two years later of Leicester, when in November 1531 he was consecrated Bishop of Winchester. Good Catholic though he was, he supported the royal supremacy, and wrote a treatise in defence of it, *De verâ Obedientiâ* (1535). Still, he opposed all measures tending to a doctrinal reformation, he had a principal hand in the downfall of Thomas Cromwell, and the 'Six Articles' were largely of his framing, though the story that he lost Henry's favour by an attempt to impeach Catharine Parr of heresy is not based upon contemporary authority. On Edward VI.'s accession (1547), for refusing to comply with the new teaching he was committed to the Fleet prison, but released three weeks afterwards, to be next year again seized and lodged in the Tower, and in 1552 deprived of his bishopric. When in 1553 Mary ascended the throne, he was set at liberty, restored to his see, and appointed Lord High Chancellor of England. He now took the lead in the persecution of the Protestants, and has been charged with the grossest cruelty. Dr Maitland shows, however, that in very many instances the parties brought before his court were arraigned for treason rather than heresy; and certain it is that

he helped Peter Martyr to leave England, and interposed to protect Roger Ascham. He died very wealthy at Whitehall, of the gout, on 12th November 1555, and was buried in his cathedral. On his deathbed he cried out in Latin, 'I have denied with Peter, I have gone out with Peter; but I have not wept with Peter'—referring doubtless to his temporary renunciation of the papal supremacy. We have a dozen Latin and English treatises from his pen; but the *Necessary Doctrine and Erudition of a Christian Man* (1543) was probably Henry's own, not a joint production of Gardiner and Cranmer. Gardiner's character has been the subject of much debate; but it can scarcely be doubted that he was a zealous, though not a spiritually-minded, churchman. His devotion was that of an out-and-out partisan; but it was none the less real, for he would have laid down his life for the cause which commanded his sympathies. See the article by J. Bass Mullinger in vol. xx. of the *Dict. Nat. Biog.* (1889).

Gardner, a post-village of Massachusetts, 70 miles WNW. of Boston by rail, with manufactures of wooden wares—chairs, pails, tubs, and toys. Pop. (with South Gardner) 7283.

Garfield, James Abram, twentieth president of the United States, was born in Orange, Ohio, 19th November 1831. His father, who was descended from one of the Puritan founders of Watertown, Massachusetts (1630), died soon after the boy's birth, leaving his wife, the daughter of a Huguenot family that had settled in New England in 1685, to bring up unaided her four small children, battling bravely with poverty and privation in her lonely cabin in the 'Wilderness' (now the 'Western Reserve') of Ohio. At the age of ten young Garfield already added something to his mother's income by work on the neighbouring farms; in winter he made steady progress in the district school. In 1849 he entered Geauga Seminary, at Chester, Ohio; and in the summer months he turned to any and all kinds of work, to provide funds for the ensuing winter. At this period Garfield joined the Campbellite body. He next passed on to the college at Hiram, Ohio, supporting himself meanwhile by tuition, and finally graduated at Williams College, Massachusetts, in 1856. Returning to Hiram, he became its president in 1857, at the same time preaching and studying law. He was elected to the state senate in 1859, and on the outbreak of the war received the command of the 42d regiment of Ohio volunteers. In December 1861 he was given a brigade, with orders to drive the Confederates out of eastern Kentucky, and with reinforcements gained the battle of Middle Creek, 10th January 1862, from which his commission as brigadier-general was dated. He had been promoted major-general for gallantry at Chickamauga, September 19, 1863, when he resigned his command to enter congress, at the age of thirty-two. He sat in congress, rendering valuable assistance in military and financial questions, until 1880, and acted latterly as leader of the Republican party in the house. In January 1880 he was elected a United States senator, and in June of the same year he was adopted as presidential candidate by the Republican convention at Chicago. Garfield's nomination came as a surprise to his party, and was simply the result of a compromise between the supporters of Grant and Blaine, after thirty-three ineffectual ballots had proved that neither could secure the prize. He proved, nevertheless, a strong candidate, regardless of precedent delivered speeches in his own behalf, and finally defeated General Hancock by a narrow majority on the popular vote, but by 215 to 155 electoral votes. He was inaugurated on 4th March 1881, and identified himself with the cause of civil service reform, whereby he irritated a powerful section of his own party (see Conkling). On the morning of 2d July, as he was setting off to witness the closing exercises of his old college, he was shot down from behind by a disappointed office-seeker, Charles Guiteau. For weeks he lingered between life and death; early in September he was removed to Long Branch, New Jersey, and there he died, at Elberon, 19th September 1881. He was buried at Cleveland (q.v.). The vice-president, General Arthur (q.v.), succeeded him. Garfield held power long enough to show himself worthy of it. His tragic death has given him prominence in the roll of American presidents, but it was his brave and patient endurance of suffering that endeared him most to his countrymen and claimed the sympathy and admiration of the rest of the world. His speeches were collected in 2 vols. (Boston, 1882). Popular memoirs are numerous; the most complete Life is that by J. R. Gilmore (New York, 1880).

Garcloch. See Dumbartonshire.

Gar-fish. See Gar-pike.

Gar'ganey. See Teal.

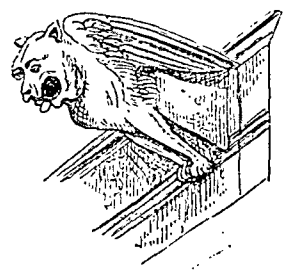
Gargano (ancient *Gargānus*), a mountainous peninsula, the 'spur' of Italy, in the province of Foggia, jutting out some 30 miles into the Adriatic Sea, and attaining in Monte Calvo a height of 5110 feet. Bee-keeping is yet as generally engaged in as in the time of Horace. The district is visited mainly by pilgrims to a shrine of St Michael on Monte St Angelo.

Gargantua. See Rabelais.

Gargarus. See Ida.

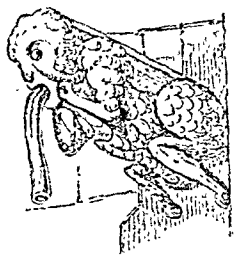
Gargle, or Gargarism, a class of medicines intended to be churned about in the throat, with a view of cleansing the parts, and of acting as antiseptics, Astringents (q.v.), sedatives, or Stimulants (q.v.), in various conditions of the throat. In using them a full breath is taken, the mouth filled with the liquid, and the head thrown back; as the breath is gradually allowed to escape, the liquid is freely brought into contact with the upper part of the throat. They are not generally suitable in cases of acute inflammation of the throat, but often valuable in chronic affections. Among the most useful gargles are—Antiseptic: Condy's fluid, 10 to 20 drops; carbolic acid, 4 to 8 grains. Astringent: tannic acid, 10 grains; alum, 20 grains. Sedative: bromide of potash, 20 grains. Stimulant: vinegar, 30 drops; dilute hydrochloric acid, 20 drops, dissolved or diluted with a wineglassful of water.

Gargoyle, a projecting spout, leading the water from the roof-gutters of buildings. Gargoyles of various forms have been used in almost all styles of architecture, but were peculiarly developed in connection with Gothic architecture. Some gargoyles are small and plain, others large and ornamental, according to their various positions. They are carved into all conceivable forms—angelic, human, and of the lower animals; and, as in fountains, the water is generally spouted through the mouth. In late castellated buildings, they frequently assume the form of small cannons projecting from the parapet. Gargoyles are generally carved in stone, but are



St Stephen's, Vienna.

sometimes executed in wood, and are made of great length so as to throw the water into the gutter formed in the middle of the streets of some



St Alkmund's Church, Derby; *circa* 1450.

Horsley Church, Derbyshire; *circa* 1450.

old towns. In modern times the use of leaden pipes to convey away the water from roofs has almost entirely superseded the use of gargoyles.

Garhmukhtesar, an ancient town in the North-west Provinces of India, on the Ganges, 26 miles SE. of Meerut, with four shrines dedicated to Gangâ, and a great fair, which attracts 200,000 pilgrims. Pop. 7305.

Garhwal, a native state in the North-west Provinces of India, on the borders of Tibet: area, about 4180 sq. m.; pop. (1881) 199,836. Also the name of a British district in the North-west Provinces, next to independent Garhwal: area, 5500 sq. m.; pop. 345,629. Being on the southern slope of the Himalayas, Garhwal is for the most part a mass of rugged mountain-ranges, whose elevation above the sea reaches in Nanda Devi 25,661 feet. The native state is the cradle of both the Jumna and the Ganges, and in the district are the Alaknanda and its point of junction with the Bhagirathi (see GANGES); consequently, in spite of the length and ruggedness of the way, crowds of pilgrims are attracted to the peculiarly sacred localities of Deoprayag and Gangotri.

Garibaldi, GIUSEPPE, the Italian patriot, was born at Nice on the 4th July 1807. His father was a simple, God-fearing fisherman, seldom in prosperous circumstances, but he contrived nevertheless to give the boy a tolerable education, possibly with the object of making him a priest. Giuseppe, however, was determined upon becoming a sailor, and rising rapidly in the merchant-service, he was appointed in 1828 second in command of the brig *Cortese*. His early voyages, which included a visit to Rome, filled him with democratic ardour, whence it is only natural that in 1834 he should have been involved in the 'Young Italy' movement of Mazzini, whom he met at Marseilles, and should have been condemned to death for taking part in an attempt to seize Genoa. He had volunteered for the royal navy with the object of gaining recruits for the cause. Garibaldi escaped to Marseilles and afterwards to South America, where he offered his services to the province of Rio Grande, which was in rebellion against the Emperor of Brazil. He distinguished himself as a guerilla warrior and privateer, was taken prisoner and suspended for two hours by the wrists for attempting to escape, and eloped with and soon married the beautiful creole Anita Riveira de Silva, the companion of his earlier campaigns and the mother of his children Menotti, Ricciotti, and Teresa. After some mingled experiences as drover, shipbroker, and teacher of mathematics, he offered in 1842 his assistance to the Montevideans, who were at war with Rosas, the tyrant of Buenos Ayres. In this struggle Garibaldi won fresh renown, by water as naval commander in a two days' engagement, and on land as organiser and commander of the Italian legion, especially on 8th February and 20th May 1846, when he beat off considerably superior forces of the enemy at Salto San Antonio and the Dayman River. He gives a full account of his various exploits in his autobiography.

The 'red shirt' of Garibaldi had thus already become famous, when in 1847 the reforming pope, Pius IX., ascended the throne of St Peter. Garibaldi, the Montevidean struggle being practically at an end, promptly offered to enlist under his banner, but received an ambiguous reply; and Charles Albert of Sardinia, whom on his arrival in Italy in June 1848 he found besieging the Austrians in Mantua, coldly referred him to his ministers. Garibaldi, however, after the collapse of the Italian army, at the head of a body of volunteers performed some notable feats against the Austrians on the Swiss frontier, and then wandered about Italy until he reached Ravenna. In 1849 he threw in his lot with the revolutionary government of Rome against Pius IX., who had retracted his liberal concessions and fled the city. Garibaldi, indeed, voted for the proclamation of the republic in February, drove the French expeditionary force under Oudinot from the Porta San Pancrazio in April, and routed the Neapolitans at Palestrina and Velletri in May, sending them pell-mell over the frontier. Meantime, however, Mazzini had been inveigled by Oudinot into an armistice; and, being abundantly reinforced, the French proceeded to lay siege to Rome. Garibaldi was recalled, much to his disgust. He was refused the dictatorship on June 2, and on July 3, after a brilliant defence, he was forced to abandon his post. He retreated, pursued by the Austrians, to the Adriatic, where poor Anita, worn out by suffering and anxiety, died, and was buried in the sand. Garibaldi was at length arrested by the orders of the Sardinian government at Chiavari, and requested to leave Italy, much to the indignation of the people. He betook himself to Staten Island, New York, where he worked for eighteen months as a candlemaker, then became captain of various merchantmen, paying a visit to Newcastle, where he declined a popular demonstration.

He returned to Italy in 1854, and had settled down as a farmer on the island of Caprera, when in 1859 the outbreak of the war of Italian liberation called him to arms once more. He was summoned to Turin by Cavour in February, and at once placed his sword at the disposal of Victor Emmanuel. Though frequently thwarted by the Sardinian generals, Garibaldi and his 'chasseurs of the Alps' rendered valuable service to the allies, especially at Varese in the Valtelline (May 25). After the peace of Villafranca, Garibaldi, with the permission of Victor Emmanuel, went into central Italy as second in command, and helped to consummate the annexation of the territories to Sardinia, but was not allowed as he desired to march on Rome. He was cut to the quick when his native Nice was handed over to France, and declaimed against Cavour in the chamber at Turin. Meanwhile the Mazzinists had been busily conspiring against the effete Bourbon tyranny in the Two Sicilies, and Garibaldi, in spite of Cavour's efforts to prevent him, prepared to come to the rescue. The enterprise appeared dangerous in the extreme; but, as the English cabinet insisted on the neutrality of France, the Bourbons could look for no foreign assistance, and 'the thousand heroes' on landing at Marsala on May 11 met but a feeble enemy. With the exception of the garrison of Milazzo, which capitulated after a battle on July 24, the disaffected troops of Francis II. fought half-heartedly enough, and within three months Sicily was free. Promptly crossing the straits (August 29) Garibaldi began his military

promenade through Naples, and entered the capital (September 7) amid the cheers of King Francis' troops. After a last stand on the Volturno on October 1, the Bourbons took refuge in the citadel of Gaeta. Then Victor Emmanuel, having been elected sovereign of the Two Sicilies by a plebiscite, arrived at Naples, and Garibaldi, refusing all reward, resigned his dictatorship and retired to Caprera. His conduct entailed a quarrel with the Republican party, and he was besides disgusted by the refusal of the Italian ministry to enrol his veterans in the regular army, and at not being allowed to march on Rome and destroy the hated papal government. In this he saw the hand of Cavour, but later publications show that he was mistaken as far as the volunteers were concerned.

During the ensuing years Rome was the centre of his thoughts, though shared with schemes for stirring up rebellion in Hungary, and so causing the Austrians to withdraw from Venice, and in 1862 he embarked on a rash expedition against the capital. If the king and the weak Rattazzi cabinet did not actually egg him on, as Garibaldi said they did, they at all events sat still and allowed him to compromise himself, and then sent troops against him; by whom Garibaldi was taken prisoner at Aspromonte after he had given orders to his troops not to fire (August 28). Badly wounded in the foot, Garibaldi was detained for two months as prisoner at Spezzia, and was then allowed to return to Caprera. He next paid a visit to England to induce the government to espouse the cause of Denmark, and was received with the wildest enthusiasm; but failing to effect the object of his journey, he returned abruptly home at the request of the cabinet. In the war of 1866 he once more commanded the 'Red Shirts' in the Tyrol, but, though his sons Menotti and Ricciotti proved worthy of their father, the campaign as a whole was not marked by very brilliant affairs. Garibaldi accused the government of neglecting to forward men and arms, and their conduct seems to have been marked by unworthy suspicions. Venice was now ceded to Italy, but Rome still remained unredeemed, and, untaught by his previous adventures, Garibaldi in the following year made his last attempt on the Holy City. Arrested on September 22 by the Italian government—whose hands were tied by the convention with France of 1864—he escaped from Caprera in a boat, and placing himself at the head of the volunteers, defeated the papal troops on October 25 at Monterotondo. On November 3, however, the Zouaves, reinforced by a body of French armed with the deadly chassepot, utterly routed him at Mentana. Once more he was allowed to retire to Caprera, whence in 1870 he sent for publication two novels, entitled *Cantoni il voluntario* and *Clelia, ovvero il Governo del Monaco*. The latter has been translated into English under the title of the 'Rule of the Monk,' but it must be confessed that Garibaldi did not shine as an author, and that the average schoolboy could write as well. In 1872, however, he published a third romance, *Il Mille*, based on the events of the Sicilian expedition. In 1870, though at first a sympathiser with Germany, owing to his hatred of Napoleon III., he resolved to come to the assistance of the French Republic. Gambetta did not receive him with much enthusiasm, but eventually placed him in command of the volunteers of the Vosges. Badly crippled by rheumatism, however, and hopelessly outnumbered, he confined his movements to the neighbourhood of Dijon and Autun. Even so his troops distinguished themselves, especially on 20th January 1871, when Ricciotti beat off a body of Prussian Pomeranians near Dijon. The Prussian general, Manteuffel, has left a favourable estimate of his tactics during the campaign. Garibaldi was elected to the Assembly at Bordeaux by Dijon, Nice, and Paris, but, as a foreigner, was not allowed to address the deputies.

During the remainder of his life he remained a helpless invalid at Caprera, except on occasions like that in 1874, when he took his seat in the Chamber of Deputies at Rome; and through the generosity of his English friends he became entire proprietor of the island. In 1880 the marriage into which he had been entrapped by an adventuress as far back as 1859 was annulled, and he was promptly united to Francesca, his peasant-companion, who had originally come to the island as nurse to the children of his daughter Teresa, the wife of Stefano Canzio, one of his officers. During the last years of his life manifestoes poured from his pen, in which professions of devotion to the Sardinian dynasty alternated with the wildest republicanism; and his simplicity, like that of Victor Hugo, was easily persuaded to endorse any document containing the commonplaces of cosmopolitanism. But he was ever constant to the ideal of his youth, the unity of the Italian-speaking race. Thence came his participation in the 'Irridentist' agitation; thence too his undying hatred of the papacy. More practical was his advocacy of the creation of a mercantile navy and the reorganisation of the army, and his interest in the drainage of the Campagna and the diversion of the Tiber; but the last project had no adequate result. His religious views latterly embraced a somewhat elementary pantheism: 'God did not make man,' he wrote, 'but man made God,' and death he looked upon as a transmutation of matter. On 2d June 1882 he died, and was sincerely mourned, not only by his fellow-countrymen, but by the lovers of liberty throughout Europe. For though as a soldier he was perhaps nothing more than a good commander of irregulars, and though his ignorance of political considerations sometimes did actual harm to the cause he advocated, yet it would be impossible to overrate the importance to Italian unity of his whole-souled devotion to his country, a devotion which he communicated to all with whom he came in contact. He will always remain the central figure in the story of Italian independence.

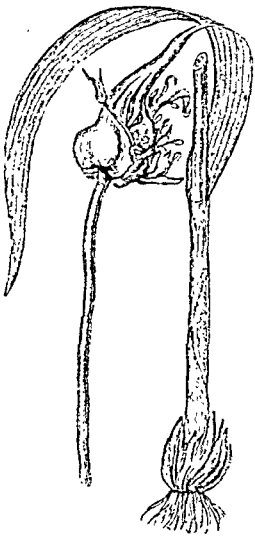
Garibaldi's autobiography was published in 1887, and an English translation with a supplementary biography by Mme. Mario in 1889. The best general sketches of Garibaldi are to be found in J. T. Bent's *Life of Garibaldi*, and in Mme. Mario's *Garibaldi e i suoi Tempi* (Milan, 1884). Elpis Melena's *Garibaldi* (2 vols. Hanover, 1884) is also incidentally instructive. Garibaldi's speeches were published in 1882, and his letters, edited by E. E. Ximenes, in 1885.

Gariep. See ORANGE RIVER.

Garigliano (ancient *Liris;* in its upper course now called Liri), a river of southern Italy, rises in the Abruzzi, west of the former Lake of Fucino, and flows, after a generally southerly course of 90 miles, into the Gulf of Gaeta. It is navigable below Pontecorvo, and abounds with fish. On its banks in 1503 was fought a famous battle between the French and the Spaniards, commanded by Gonsalvo de Cordova, in which the former were totally routed, though Bayard is said single-handed to have held the bridge against 200 Spaniards.

Garlic (*Allium sativum*, see ALLIUM), an herb cultivated from the earliest ages on account of its wholesome and characteristically flavoured bulbs. These break readily up into a dozen or more 'cloves' or subordinate bulbs, which are the developed axillary buds of the exhausted scale-leaves of the parent bulb; and this circumstance is of much service, alike in cultivation and in regulating

the quantity used in cooking. This varies greatly with national taste, from a maximum in Spain to a minimum in Britain. The plant seems to have been introduced along the Mediterranean from the East in very early times, its original home being perhaps the Kirghiz steppes: it is recorded as part of the rations of the Egyptian pyramid-builders, and there perhaps the Jews acquired their fondness for it. It was, however, forbidden to the priests of Isis. The Roman soldiers were given garlic as an excitant (whence the peace-loving maxim, *allium ne comedas*); and the same regimen was applied in the still recent days of cock-fighting. It had also many medicinal applications.—Many of the species of Allium are popularly called garlic, with some distinctive addition. *A. oleraceum* is sometimes called Wild Garlic in England, and its young and tender leaves are used as a pot-herb.



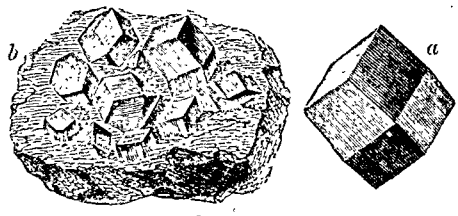
Common Garlic (*Allium sativum*).

Garlic, Oil of. When the leaves, seeds, or bulbs of garlic and other allied plants are distilled with steam, about 0·2 per cent. of a brown oil, with acrid taste and strong disagreeable odour, passes over. By purification it is obtained as a pale yellow oil having the odour of garlic, and it is then found to consist of the sulphide of allyl, $(C_3H_5)_2S$. This oil is nearly related to the pungent oil of mustard, C_3H_5NCS, an isomer of the sulphocyanide of allyl, and is of much interest chemically, but it is of no importance from an industrial or popular point of view.

Garnet, Henry, is chiefly remembered for his connection with the Gunpowder Plot. He was born in 1555, and educated as a Protestant at Winchester College. A few years after leaving school he became a Roman Catholic, went abroad, and entered the Society of Jesus. He acquired among the Jesuits a considerable reputation for learning and piety. In 1586 he was sent upon the English mission, where for eighteen years he acted as provincial of the Jesuits. The indiscreet zeal with which he promoted certain Jesuit schemes for the advancement of their order brought him into odium with an influential section of the secular clergy; while his friendship and correspondence with the extreme partisans of the Spanish faction brought him under suspicion of treason. In the spring of 1605 he wrote to a Jesuit in Flanders in commendation of Guy Fawkes, when that conspirator went over to the Netherlands in order to solicit the co-operation of Sir William Stanley and others in the plot of that year. Garnet admitted that before this he had come to know, in a general way, of the projected treason, and that in July he heard the particulars, under the seal of confession (so he said), from another Jesuit, Greenway. At the time of the discovery of the plot he was present at the place of meeting appointed by the conspirators, and shortly afterwards was apprehended on suspicion at Hendlip. The chief grounds for inferring his complicity in the plot were derived from a secret conversation held by him in prison with a brother Jesuit, Oldcorn, overheard by spies set for the purpose by the government.

That Garnet knew the particulars of the murderous design months before its attempted execution was proved and admitted. That this knowledge was derived exclusively from the confessional rests upon his statement only. It would probably have gone less hard with the prisoner had not his judges been prejudiced against him, not indeed so much on account of his creed as for his extraordinary practice of equivocation when on his trial. He was condemned for misprision of treason, and executed May 3, 1606. In proof of his innocence the story of a miraculous straw, touched by his blood, and bearing a miniature portrait of the Jesuit, was circulated among Roman Catholics; and it is said that the mere sight of the straw made five hundred converts to his creed. Garnet was considered by his co-religionists generally as a martyr for the seal of confession, and as such was proposed, with the rest of the victims of the penal laws, for the honour of beatification; but it is remarkable that, while more than three hundred candidates obtained the title of Blessed or Venerable, the objections of the 'devil's advocate' in the case of Father Garnet were so cogent that the pope was induced to defer the introduction of his cause. See Gunpowder Plot, and works cited there.

Garnets, a group of minerals that crystallise in the cubical system. Their commonest form is the rhombic dodecahedron, or a combination of this with the icositetrahedron. Their composition may be represented by the general formula, $M_3R_2Si_3O_{12}$, where M = Ca, Fe, Mg, Mn; R_2 = Al_2, Fe_2, Cr_2. Thus we have lime-alumina, iron-alumina, magnesia-alumina, manganese-alumina, lime-iron, and lime-chrome garnets. Garnets have a hardness ranging



Garnet:
a, a detached crystal; *b*, portion of rock with embedded crystals.

from about 7 to 8. Their lustre is vitreous and resinous, and they are rarely transparent and very seldom colourless. The most common colour is some shade of red, but brown, yellow, green, and even black varieties are known. Some of the better known kinds are as follows:

Lime-alumina Garnets.—Grossular (*grossula*, 'a gooseberry'), so called from its green colour—the tint is usually rather pale—found in Siberia and in Norway; *Essonite* or *Cinnamon-stone* (q.v.); *Succinite*, amber-coloured, from Ala, Piedmont; *Romanzovite*, brown or brownish-black, from Kimito, in Finland.

Iron-alumina Garnets.—Almandine, the *precious or oriental garnet of jewellers; red, transparent;* occurs as a rock-constituent in many crystalline schists and granites, and occasionally also in trachyte, and is met with in the sands and alluvial soils which have resulted from the disintegration of such rocks, as in Ceylon, Pegu, Hindustan, Brazil, Greenland, Scotland, &c. Iron-alumina garnets are often crowded with enclosures, have a somewhat dull lustre, and are full of flaws; such are usually known as *common garnet*. Common garnet often occurs massive, and not infrequently

forms a very considerable part of certain kinds of rock, as garnet-rock, eklogite, and granulite.

Magnesia-alumina Garnets.—These are somewhat uncommon—the best known being the black garnets from Arendal in Norway. Another is *Pyrope*, which is transparent and of a blood-red colour. *Carbuncle* (q.v.) is the name given by lapidaries to a pyrope cut *en cabochon* or 'tallow-drop.' It occurs in serpentine and in the loose soils derived from the breaking-up of that rock, as in Bohemia, where it is used as a gem. It does not occur in crystals, but in rounded or angular grains.

Manganese-alumina Garnets are met with, chiefly in small grains and crystals in schists and granites, near Aschaffenburg, in Spessart (Franconia); in the Ardennes, Piedmont, Connecticut, &c. The Franconian locality has given its name to this garnet—*Spessartine*, which is of a deep hyacinth or brownish-red. Many of the garnets which occur in the granites of Scotland are rich in magnesia, but from the abundance of ferric oxide which they contain they are included under the iron-alumina group.

Lime-iron Garnets.—Of these the most important is *Melanite*, velvet-black and opaque; it occurs as a rock-constituent in various volcanic rocks (phonolite, leucite-lava, and tuff), as at Frascati (Albano Mountains, near Rome), Laacher See, near the Rhine, Oberbergen (Kaiserstuhl), &c. Other varieties are *Topazolite*, yellow, green, and greenish-yellow; *Aplome*, green, brownish, and sometimes yellow.

Lime-chrome Garnets.—Uwarowite, an emerald-green garnet, translucent at the edges, found in the Urals.

The garnets of commerce are brought from Bohemia, Ceylon, Pegu, and Brazil; the most esteemed kinds (coming originally from Syriam, in Pegu) are vulgarly called *Syrian* garnets. They are violet-purple; and now and again very fine specimens almost vie in colour with the oriental amethyst. The stones vary in size from the smallest that can be worked to the size of a hazel-nut. Larger ones are common enough, but these are rarely free from flaws or impurities.

Garnett, RICHARD, philologist, was born at Otley, in Yorkshire, in 1789. He had already tried commerce and the church, when in 1838 he found his work in the appointment of assistant-keeper of printed books at the British Museum. He died in 1850. One of the founders of the Philological Society, he contributed many striking papers (on Celtic subjects, largely) to its *Proceedings* and to the *Quarterly Review*. These were collected by his son in *Philological Essays* (1859).—RICHARD, his son, was born at Lichfield, February 27, 1835, and appointed in 1851 assistant in the printed book department of the British Museum, where also he became superintendent of the reading-room in 1875. This office he resigned in 1884 to devote himself more exclusively to the printing of the Museum Catalogue, of which he had had charge from its commencement. He received the degree of LL.D. from Edinburgh in 1883. Dr Garnett has published three volumes of verse; *Relics of Shelley* (1862), *Selections of Shelley's Poems* (1880) and *Letters* (1882); and *De Quincey's English Opium Eater* (1885). He has also achieved the rare feat of a sensible little book on Carlyle (1883), and published a volume of prose tales, *The Twilight of the Gods* (1888). His pen has been busy also in contributing to magazines and encyclopædias.

Garnier, FRANCIS, sailor and traveller, was born at St Etienne, 25th July 1839, and entering the navy fought in the Chinese war (1860–62). Appointed to a post in French Cochin-China, he promoted a great exploring expedition, of which he ultimately assumed the command. Starting from the coast of Cambodia (q.v.), the expedition travelled to Shanghai by way of Yunnan. He took part in the defence of Paris in 1870–71, and subsequently travelled again in China. In the Tonkin war he took Hanoi, but was killed, 2d December 1873. His chief work is *Voyage d'Exploration en Indo-Chine* (2 vols. 1873). See Petit's *Francis Garnier* (Paris, 1885).

Garnier, ROBERT (1534–90), a French tragedian, the most distinguished of the predecessors of Corneille (see DRAMA). Editions of his plays have appeared at Paris (1607), Rouen (1618), and Heilbronn (1883).

Garnier-Pages, ETIENNE JOSEPH LOUIS, was born at Marseilles, 27th December 1801, and practised there as an advocate, but at Paris in 1830 took a conspicuous part in the July revolution, and in 1831 became a prominent member of the Chamber. He died 23d June 1841.—His half-brother, LOUIS ANTOINE, born 16th July 1803, also shared in the July revolution, and succeeded his brother in the Chamber, leading the extreme Left. He became in 1848 mayor of Paris and finance-minister of the provisional government; was a republican member of the Corps Legislatif in 1864; and was a member of the provisional government of 1871. He died in Paris, 31st October 1878. He wrote the *Histoire de la Revolution de 1848* (1861–62), and *L'Opposition et l'Empire* (1872).

Garnishee. In English law, to garnish (Fr. *garnir*) is to warn, and the garnishee is a person warned not to pay money which he owes to another, because the latter is indebted to the *garnisher* who gives the warning. See ATTACHMENT.

Garo Hills, a mountainous district forming the south-west corner of Assam, with an area of 3146 sq. m., and a pop. (1881, partly estimated) of 109,548. The hills, low in the north, rise to 4650 feet in the Tura range, which is the source of several tributaries of the Brahmaputra, and constitutes an important watershed; the average rainfall here is over 126 inches. The district was first placed under separate administration in 1866.

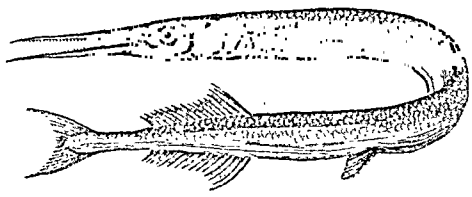
Garonne (anc. *Garumna*), the principal river in the south-west of France, rises within the Spanish frontier in the Val d'Aran, at the base of Mount Maladetta, in the Pyrenees, 6142 feet above sea-level. About 26 miles from its source it enters the French territory in the department of Haute Garonne, flows in a general north-east course to Toulouse, then bends to the north-west, and continues to flow in that direction until, joined by the Dordogne, about 20 miles below Bordeaux, and widening afterwards into the estuary which bears the name of the Gironde, it enters the Atlantic at the Pointe de Grave. The estuary, the largest in France, is nearly 50 miles long. The total length of the river is about 346 miles; it drains an area of some 22,020 sq. m. Its navigation, which, however, is much impeded above Toulouse, commences for small craft at Cazères; ocean steamers go up to Bordeaux. Its principal affluents are the Tarn, Lot, and Dordogne, on the right; and on the left, the Save, Gers, and Baise. At Toulouse it is joined by the Canal du Midi, which, running eastward to the Mediterranean, forms with the Garonne a means of communication between that sea and the Atlantic; and the river's own *canal latéral*, starting also from Toulouse, runs along the right bank, receives the Montauban Canal, and spans several streams in its course, crossing the Garonne itself at Agen by a magnificent viaduct, and returning to the river at Castets, after a total length of 120 miles. The valley of the Garonne is noted for the beauty of its scenery, but is liable to destructive inundations, the most memorable being that of

1875, when damage to the amount of 85 million francs was caused.

Garonne, HAUTE, a department in the south of France, embracing portions of ancient Gascony and Languedoc, has an area of 2428 sq. m., and a pop. (1872) of 479,362; (1886) 481,169. It is watered throughout by the Garonne, from which it derives its name, and within the basin of which it wholly lies. Occupied in the south by a branch of the Pyrenean range, the slope of the department and the course of its streams are toward the north and north-east. Apart from this southern mountainous region, the department is hilly and fertile. The soil in the valleys is remarkably productive, and bears heavy crops of wheat, maize, flax, hemp, potatoes, and rape-seed. Orchard fruits and chestnuts are produced in abundance, and the annual yield of wine is about 20,000,000 gallons, two-thirds of which is exported. Mineral springs and baths are very plentiful. The chief manufactures are woollen and cotton fabrics, paper, and hardware. The department is divided into the four arrondissements of Toulouse, Muret, St Gaudens, and Villefranche, with Toulouse as capital.

Garotte. See GARROTTE.

Gar-pike (*Belone*), a genus of bony fishes in the family Scombresocidæ, not far from the true pikes (Esocidæ). They have long bodies, and both jaws are prolonged into a slender beak, beset with roughnesses and widely set teeth. They swim actively, with an undulating motion, near the surface, and catch small fishes in their jaws. The common Gar-pike (*B. vulgaris* or *B. belone*) is frequent off British coasts, and is sometimes called Greenbone, from the colour of the bones (especially after cooking), Gorebill, from its characteristic beak, or Mackerel-guide, because it visits



Gar-pike (*Belone vulgaris*).

the coasts just before the mackerel. It is usually about two feet in length, is often brought to the London market, and forms a wholesome dish, in flavour somewhat like mackerel. About fifty species are known from tropical and temperate seas, some twice as long as the British species. The young forms have at first jaws of a normal size, and in growth the lower outstrips the upper. The name Gar-pike is sometimes applied to the far-removed Ganoid-Lepidosteus, or Bony Pike (q.v.).

Garrett, ELIZABETH. See ANDERSON.

Garrick, DAVID, actor, manager, and dramatist, was born on 20th February 1717, at Hereford, where his father, Captain Peter Garrick, was then stationed. Lichfield, however, was the home of the Garricks, and it was in the grammar-school there that David received the chief part of his education, for he must have been in his nineteenth or twentieth year before he was sent to study Latin and Greek under Samuel Johnson, at Edial near Lichfield. His tuition by Johnson lasted for only a few months, and its well-known result was the setting out of master and pupil together, on the morning of 2d March 1737, to journey to London; Garrick to study 'mathematics, and philosophy, and humane learning,' with a view to the bar; Johnson 'to try his fate with a tragedy, and to see to get himself employed in some translation, either from the Latin or the French.' But circumstances brought Garrick's legal studies to nothing, and in 1738 he became a wine-merchant, in partnership with his eldest brother, Peter. Samuel Foote in after years used to say that 'he remembered Garrick living in Durham Yard, with three quarts of vinegar in the cellar, calling himself a wine-merchant.' Garrick, there is no doubt, already had the stage fever, and his attention was probably more taken up with plays and players than with business, so it is not surprising that in 1740 the partnership was dissolved. Garrick then devoted his mind to preparing himself for his intended profession, and in the summer of 1741 made his first appearance as an actor. He did not venture at once to play in London, but went through a short probationary season at Ipswich, playing under the name of Lyddal. His first part was Aboan in Southerne's *Oroonoko*, which he chose because Aboan's black face disguised him and gave him greater confidence. He subsequently played with great success several other parts, including Harlequin. On 19th October 1741 he appeared in London at the theatre in Goodman's Fields, of which his friend Giffard was manager. Richard III. was his first character, and his success was so great that within a few weeks the two patent theatres were deserted, and crowds flocked to the unfashionable East-end playhouse. But Goodman's Fields had no license, so the managers of Drury Lane and Covent Garden set the law in motion and had the theatre closed. Garrick played at both the patent theatres, but ultimately settled at Drury Lane, of which he became joint-patentee with James Lacy in 1747. Until 1776 he continued to direct the leading theatre, and in that year he retired from the stage and from management, his successor in the direction of the theatre being Richard Brinsley Sheridan. During this period Garrick was himself the great attraction and played continually, his only long rest being a trip to the Continent from 1763 to 1765, at which time he fancied that his popularity was in danger of diminishing. His farewell appearance was made on 10th June 1776, when he played Don Felix in the comedy of *The Wonder*. He died on 20th January 1779, and was buried in Westminster Abbey, where a hideously theatrical monument was erected to his memory. As an actor, Garrick occupies the first rank. At his coming the stage was given over to formality and tradition, but these disappeared before the new actor whose leading characteristic was naturalness. He possessed also the most astonishing versatility, being equally at home in tragedy, comedy, or farce—in Lear, Don Felix, or Abel Drugger. As a man, he has been charged with meanness, vanity, and petty jealousy; but his faults of character were grossly exaggerated by those who envied his fame, and they were more than balanced by his many excellent qualities. Garrick's dramatic productions, some forty in number, are of minor importance, but some of his numerous prologues and epilogues are excellent. Garrick married in June 1749 a good and excellent woman, Eva Maria Violette, the celebrated dancer. She long survived him, dying in 1822, at the great age of ninety-seven. See Percy Fitzgerald's *Life of David Garrick* (2 vols. 1868).

Garrison, WILLIAM LLOYD, journalist and abolitionist, was born at Newburyport, Massachusetts, December 10, 1805. His father was a man of literary taste and ability, but, falling into dissolute habits, deserted his wife, who, to support her family, had to turn professional nurse. William, who had previously tried shoemaking and cabinet-

making, was apprenticed to the printer of the *Newburyport Herald*, an occupation which suited his taste; he soon made himself master of the mechanical part of the business, and when only sixteen or seventeen began to write for the *Herald*. His contributions, which were anonymous, were favourably received, and he soon commenced to send articles to the *Salem Gazette* and other papers, drawing the attention of political circles by a series of articles under the signature Aristides, with the view of removing the almost universal apathy on the subject of slavery. In 1824 he became editor of the *Herald*, and some of J. G. Whittier's earliest poems were accepted by him, while their author was yet unknown to fame. After two or three other attempts, in 1829 he joined Mr Lundy at Baltimore in editing the *Genius of Universal Emancipation*. The vigorous expression of his anti-slavery views in this last paper led to his imprisonment for libel, from which he was released by Mr Tappan, a New York merchant, who paid his fine. He now prepared a series of emancipation lectures, subsequently delivered in New York and other places. He returned to Boston, and in 1831 started the *Liberator*, without capital or subscribers, a paper with which his name is inseparably associated, and which he carried on for thirty-five years, until slavery was abolished in the United States. For the first few years the mail brought hundreds of letters to Garrison, threatening his assassination if he did not discontinue this journal; the legislature of Georgia offered a reward of 5000 dollars to any one who should prosecute and bring him to conviction in accordance with the laws of that state; in 1835 he was severely handled by a Boston mob, and the mayor of that city was constantly appealed to from the South to suppress his paper. In spite of all, he successfully persevered. In 1833 he visited Great Britain, and on his return organised the American Anti-slavery Society, of which he was afterwards president. He visited England again, in the furtherance of his anti-slavery opinions, in 1846 and 1848. The diverging views of the anti-slavery party, as to whether a political platform should be adopted, and as to the voting and speaking of women, rent the body for a time, but on 1st January 1863 Lincoln's proclamation of freedom to the slaves as a military measure placed the civil struggle on an anti-slavery basis. In 1865, when Garrison's labours had been completely successful, and after the total abolition of slavery in the United States, his friends presented him with 30,000 dollars (£6000) as a memorial of his services. In 1867 he was once more in England, and entertained at a public breakfast in St James's Hall. He died at New York, 24th May 1879. A bronze statue has been erected to his memory in Boston. Some *Sonnets and other Poems* by him were published in 1847, and *Selections from his Writings and Speeches* in 1852. See Johnson's *William Lloyd Garrison* (1882); *William Lloyd Garrison: the Story of his Life*, by his children (4 vols. 1885–89); and poems to his memory by both Whittier and Lowell.

Garrot, a name applied to various ducks—e.g. to *Fulix clangula* and *Harelda histrionica*. See WILD-DUCK.

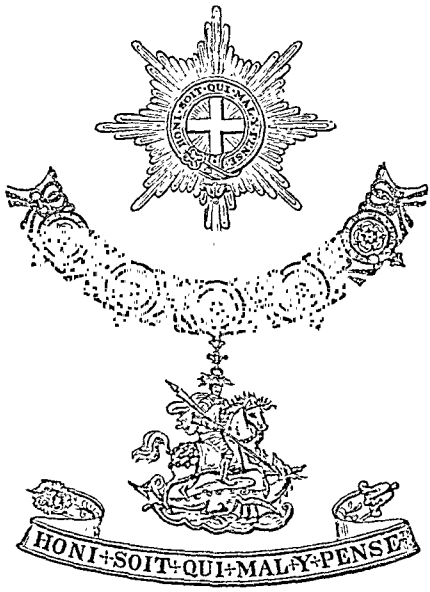
Garrotte (Span. *garrote*, 'a stick or cudgel'), a mode of execution practised in Spain and the Spanish colonies. Originally it consisted in simply placing a cord round the neck of a criminal, who was seated on a chair fixed to a post, and then twisting the cord by means of a *stick* (whence the name) inserted between the post and the back of the neck, till strangulation was produced. Afterwards a brass collar was used, containing a screw, which the executioner turned till its point entered the spinal marrow where it unites with the brain, causing instantaneous death. In its primitive form it exactly resembles the punishment of the bow-string in use among Mohammedan nations.—Garrotting is also the name given in Britain to a species of robbery which became rather common in the winter of 1862–63, and in which the robbers suddenly come behind their victim, and half-strangle him till their purpose is effected. An act passed in 1863 imposing Flogging (q.v.) as part of the penalty was effective in speedily suppressing the offence.

Garter, THE MOST NOBLE ORDER OF THE. This renowned order of knighthood was instituted by King Edward III., at what exact date has been matter of dispute, but most probably on 18th January 1344. Edward, having laid claim to the French throne, assumed the style of king of France. He had been partially successful in his first French campaign, and, meditating a second expedition, he resolved to institute an order of knighthood in honour of his successes past and to come, and as a means of rewarding some of his most distinguished comrades in arms. Hence the colour of the emblem chosen was blue, the French livery colour, and the motto, *Honi soit qui mal y pense* (i.e. '*Dishonoured be he who thinks ill of it*'), was appropriate whether it applied to the French expedition or to the order itself. The tradition is that the choice of both emblem and motto was determined by a trivial incident. The Countess of Salisbury dropped her garter when dancing with the king, and the king, picking it up, tied it round his leg; but, observing the queen's jealous glances, he returned it to its fair owner with the remark, *Honi soit qui mal y pense*. The order was originally founded in honour of the Holy Trinity, the Virgin Mary, St George of Cappadocia, and St Edward the Confessor; but St George was always accounted its especial patron, so much that it has sometimes been called the 'Order of St George.' By the original constitution the Knights Companions were to be twenty-five in number exclusive of the sovereign, and were to assemble yearly on the eve of St George in St George's Chapel, where each was assigned a stall. Subsequent statutes authorised the admission into the order, in addition to the twenty-five companions, of foreigners of distinction, and such descendants of George II. (extended to descendants of George I. in 1831) as should be elected, always excepting the Prince of Wales, who was of necessity a companion; also of extra knights, which last, however, have always, on vacancies occurring, been incorporated into the number of the twenty-five companions.

The habits and ensigns of the order originally consisted of the garter, surcoat, mantle, and hood, to which were afterwards added the collar and George, the star, and the under habit.

This order has, unlike all others, for its principal emblem neither chain nor badge, but the *garter*, which, at first of light-blue silk with the motto sometimes set in pearls, rubies, and diamonds, is now of dark-blue velvet about an inch wide, with the motto in gold letters. It is worn on the left leg a little below the knee; and when the sovereign is a queen, she wears it, as sovereign of the order, on the left arm above the elbow. The statutes forbade the companions to appear in public without it, yet in the effigies on their monuments it is often wanting. The practice of surrounding the armorial insignia of the companions with the garter began in the reign of Henry V.; and the first sovereign on whose tomb this usage was complied with was Henry VII. An embroidered garter with the motto of the order seems to have been formerly worn on the left arm of the wives of companions.

The manifold variations in the colour, form, and material of the mantle, surcoat, and under habit at different times need not be described here. As at present worn, the *mantle* is of purple velvet lined with white taffeta, having on the left shoulder the *badge* of the order, namely, a silver escutcheon charged with a red cross for the arms of St George, and encircled with the garter and motto, as in the annexed cut. In chapters it is worn over the uniform or court dress. The *surcoat*, a short gown without sleeves, is made of crimson velvet lined like the mantle with white taffeta. The *hood*, worn on the right shoulder of the mantle, and now a meaningless appendage, is made of the same velvet as the surcoat, and similarly lined. When it ceased to serve its original purpose of a covering for the head, a cap was introduced in its place, which is now ornamented with ostrich-feathers, and in the centre of them a lofty tuft of black heron's feathers, the whole attached to the hat by a clasp of diamonds.



Order of the Garter:
Star, Collar and George, and Garter.

The *under habit*, introduced by Charles II., need not be described in detail, and the costume is completed by white silk hose and white shoes and red heels. The garter worn on the right leg is of white silver riband with a large silver rosette. The sword is straight, of an ancient pattern with a cross-guard hilt, all gilt, the scabbard of crimson velvet.

The *collar* was introduced by Henry VII., probably in consideration of a similar ornament being the principal ensign of the Golden Fleece and other orders instituted in the 15th century; but it was first ordered to be worn in 1544. It consists of twenty-six pieces in which interlaced knots of cords alternate with double roses, each surrounded with the garter and its motto, these roses being alternately white within red and red within white; and pendent from one of the roses is the *George*, or figure of St George piercing the dragon. The collar and George were appointed to be worn on all solemn feasts; and provision was also made for a lesser George to be worn on other occasions attached to a chain or lace of silk, for which was afterwards substituted a dark-blue riband. The lesser George is surrounded with the garter and motto.

In respect that the mantle on which are the arms of St George within the garter is only worn on special occasions, Charles I. in 1626 introduced another badge to be worn on the cloak or coat, in which the cross of St George (not in a shield) is surrounded by the garter, and, to make it more splendid, ordered the whole to be surrounded with rays of silver. While the badge worn on the ordinary dress, popularly known as the *star*, is thus irradiated, that on the mantle has remained unaltered.

On the occurrence of a vacancy, a chapter (consisting of the sovereign and six knights) is appointed to meet, in which the new companion is elected, the election being practically a form, and the choice lying with the sovereign. The knight elect, if at hand, appears and is invested. If absent, the garter and George are sent him by Garter King of Arms. In case of a foreign prince being elected, some person of distinction is sent along with Garter to invest him. In later times, the ceremony of election has often been dispensed with, the investiture taking place privately, and the ceremonies connected with installation are now done away with. Each knight has his stall in St George's Chapel, Windsor; the knight elect used to get his predecessor's stall, but a system of promotion has latterly been introduced. The garter-plates of the knights, containing their arms and style, remain permanently, and those placed there in the reign of Henry VII. rank among the most valuable heraldic relics in Europe.

The officers of the order are the Prelate, who has always been the Bishop of Winchester; the Chancellor, formerly the Bishop of Salisbury, now (in consequence of a change in the division of the respective sees) the Bishop of Oxford; the Registrar, who is the Dean of Windsor; Garter King of Arms; and the Gentleman Usher of the Black Rod.

Knights of the Garter write K.G. after their names. Though the military character of this fraternity no longer exists, it has retained till the present day its pre-eminence among the orders of knighthood of Europe. For two centuries past the twenty-five companions have been almost exclusively peers or the eldest sons of peers. See Ashmole's *Institution, Laws, and Ceremonies of the Order of the Garter* (1672); and Sir Harris Nicolas' *History of British Orders of Knighthood* (1842).

Garth, Sir Samuel, an eminent physician and fair poet, was born at Bolam, in the county of Durham, in 1660. He studied at Peterhouse, Cambridge, graduated M.D. in 1691, and next year settled in London, where he soon became famous as a physician and conversationalist. In the year 1700 he did himself everlasting honour by providing burial in Westminster Abbey for the neglected Dryden, and pronouncing a eulogium over his grave. On the accession of George I. he was knighted and appointed physician in ordinary to the king, and physician-general to the army. He died in London, January 18, 1718. Garth is best known in our literary history as the author of *The Dispensary* (1699), a mock-heroic poetical satire on those apothecaries and physicians who opposed the project of giving medicine gratuitously to the sick poor. The poem was exceedingly popular, but has long since ceased to interest a reader. In 1715 he published his topographical poem entitled *Claremont*, in imitation of Denham's *Cooper's Hill*, and in 1717 he superintended and contributed to a translation of Ovid's *Metamorphoses* by Addison, Pope, Gay, Congreve, Rowe, and other eminent contributors. Garth is now interesting chiefly for his versification as a connecting link between Dryden and Pope.

Gartsherrie. See COATBRIDGE.

Gas and Gases. Gas, a term applied by Von Helmont (1577–1644) to vapour not yet shown to be condensable, and possibly suggested by the Dutch *geest*, 'spirit,' 'ghost.' It now signifies either (1) a vaporous substance not condensed into a liquid at ordinary terrestrial temperatures and pressures, or (2) one which at ordinary temperatures is not condensable into a liquid by pressure alone. In both these senses, air under ordinary atmospheric conditions is a gas; when cold enough it is not a gas but a vapour, and pressure alone can then condense it. Sulphurous acid gas is ordinarily gaseous, but it is a 'vapour' because pressure alone will condense it at ordinary temperatures. Above 30·92° C. (87·67 F.) carbonic acid is a true gas; no pressure will then liquefy it; but at 30·92° C. a pressure of 77 atmospheres, and below 30·92° C. progressively smaller pressures will condense it; at and below that temperature (Andrews's Critical Temperature) gaseous carbonic acid is a 'vapour,' condensable by pressure alone. Saturated steam is, in the same sense, a permanent gas at all temperatures above 720·6° C.; *it cannot be liquefied by pressure unless* its temperature be below that limit. The critical temperature for hydrogen is – 240·4° C.; but the lowest temperature that has been actually produced (by the evaporation of liquid oxygen into a vacuum) is – 223° C. (Wroblewski); hydrogen alone among gases has not yet been condensed. It was believed that Messrs Cailletet of Paris and Raoul Pictet of Geneva had, in 1877, succeeded in condensing hydrogen as well as all the other gases then believed to be non-condensable; but as to hydrogen this is now considered doubtful. Hydrogen conducts itself under varying pressures and temperatures in such a way as to show that, if it could be exposed to – 240·4° C., 13·3 atmospheres' pressure would condense it (Wroblewski).

Gases have small densities: hydrogen has, compared with water, a density, at 0° C. and 760 mm. barometric pressure (32° F. and 29·922 in.), of 0·0000895682, and air a density of 0·0012932. Taking hydrogen as a standard, oxygen is very nearly 16 times, nitrogen 14, air 14·47, carbonic acid 22 times as heavy.

Gases have no free surface-boundary, but occupy any space within which they may be confined. The smaller the space within which a given quantity of gas is confined, the greater is the expansive pressure which it exerts on the walls of the containing vessel; approximately, for a given quantity at a given temperature, the pressure varies inversely as the volume (Boyle's Law, Mariotte's Law), or the pressure multiplied by the volume gives a constant product: $pv = c$. This law is fairly well obeyed by such gases as air; but in all gases, other than hydrogen, it is observed that there is with progressively increasing pressures a fall in the value of the product $p\,v$, which attains a minimum and then rises; and even with hydrogen the apparent exception has been removed by the labours of Wroblewski, who found that at very low temperatures the same phenomena were observed in that gas; and that, in general, if we draw curves representing, for a series of gases, the respective pressures at which the minimal values of $p\,v$ occur at various temperatures, then if our diagrams are so plotted out as to represent the respective temperatures and pressures in terms not of degrees or millimetres, but as multiples of the critical temperature (measured from – 273° C. as absolute zero) and of the corresponding critical pressure of each gas, the curves are, for all gases, the same. Under circumstances which are similar with respect to the critical temperature and pressure, therefore, all gases behave similarly in this respect; and hydrogen acts at – 183° C. (the temperature of boiling oxygen), but not at – 103·5° C. (the temperature of boiling ethylene), like air and other gases at ordinary terrestrial temperatures. Carbonic acid gas, in order to act like hydrogen at – 103·5° C., must be at a temperature of about 1287° C.; both are then at a temperature about five times their respective critical temperatures, measured from absolute zero. When the temperature of a given quantity of gas is altered, the product $p\,v$ is altered so as, to a first approximation, to be proportional to the absolute temperature (– 273° C. = 0° Abs.). There are, however, some abnormalities: keep the pressure constant and let the volume increase, and we have a certain coefficient of expansion under constant pressure, which is approximately $\frac{1}{273}$ of the bulk at 0° C. for each C. degree of increase in temperature; keep the volume constant and let the pressure increase, and we have a coefficient of increase in expansive pressure, which ought to be the same and is very nearly the same as the previous coefficient; but not exactly so. The former coefficient is, except in hydrogen, a very little larger than the latter; in the readily condensable gases the product $p\,v$ rises more rapidly than the absolute temperature; and with progressively ascending pressures, the rate of increase of $p\,v$ itself rises more markedly in the easily condensable gases than in air. These phenomena indicate the existence of inter-molecular forces between the particles of a gas, which manifest themselves the more clearly the nearer is the approach towards liquefaction; when the liquid state has been reached there is cohesion within the liquid. That gases are compressible by increase of pressure above the atmospheric, as well as dilatable by diminution of pressure, follows from what has been said; if the pressure be doubled the volume will be halved, and *vice versâ*. When gases are compressed, work is done upon them, and the compressed gas tends to expand; when the pressure is wholly or partly relieved, the gas expands and does work, as in the air-gun or in compressed-air machines. The pressure at all points in the same horizontal level is, or soon becomes, the same; whence, if pressure be applied to one part of a mass of gas, the pressure is soon transmitted throughout the whole, and thus energy may be conveyed, even to considerable distances. The restitution-pressure tending to cause expansion is equal to the external pressure applied; and the coefficient of elasticity is at all temperatures, provided there is no change of temperature during the compression, numerically equal to the pressure; while if the compression could be so conducted as to allow absolutely *no* heat to escape, then the elasticity would be numerically 1·406 times as great as the pressure. Through this elasticity of gases, local displacements set up wave-motions, which, mostly in air, are the usual cause of sound. The speed of propagation of such waves (unhampered by boundary walls) is equal to the square root of the quotient of 1·406 times the pressure divided by the density; and thus the velocity of sound is, within the same gas, independent of the pressure (for the pressure and the density are directly proportional to one another). It is, however, directly proportional to the square root of the absolute temperature.

According to Dalton's Law, when a number of gases are mixed, each exerts its own pressure according to the quantity in which it is present; this law is the less perfectly obeyed the nearer the gases are to their condensing temperatures, and the greater their mutual solvent action. When a gas is greatly rarefied, a small mass holds possession of a relatively great space; such a space is called a *vacuum*, which in fact it is not, for two reasons—that the ether of space is not eliminated, and that traces of the gas (one hundred-millionth of an atmosphere in the

best vacua) are always retained. If two gases be placed at different levels in a vessel, even with the lighter gas uppermost, they will rapidly diffuse into one another, and even if connected only by a long glass tube they will soon mix, and will not thereafter separate. This is due to molecular movement, and dust-particles are not appreciably transferred; thus the dust of a closet is not removed, though the air is renewed, by opening the door. If, however, the two gases to be exchanged be of notably different densities, there may be a pressure resulting from the tendency of the lighter gas to pass more rapidly into the heavier than the heavier one travels into it. The rate of mixing by diffusion between two gases is measured by their coefficient of diffusivity, which is to be experimentally found. The significance of this coefficient is that where we, adopting a consistent system of units, say centimetre, gramme, and second, state in the shape of a formula the known laws of gaseous diffusion—viz. that (1) the quantity of matter transferred across any layer is inversely proportional to the thickness of that layer, (2) that it is directly proportional to the area exposed, (3) directly proportional to the time taken, and also (4) to the difference of densities on either side of the layer—we may convert this formal statement of proportions into a numerical identity by inserting the proper numerical factor or coefficient; thus if M be the number of grammes transferred, *ab* the area exposed in sq. cm., *c* the thickness of the layer, *t* the time, and *d* the difference of densities, M is proportional to $\frac{ab.t.d}{c}$, or equal to $k.\frac{ab.t.d}{c}$, where *k* is the coefficient of diffusivity. But *k* becomes a different number when we change our units of length or time; it varies numerically according to the square of the unit of length, and inversely according to the unit of time adopted, and hence the coefficient of diffusivity is usually stated as being so many square centimetres per second. Some numerical values for this coefficient will be found in Clerk-Maxwell's *Theory of Heat* (appendix).

Diffusion in gases has also been measured in another way. Hydrogen separated from the outer air by a plaster-of-Paris plug, escapes into the air about four times as fast as air traverses the plug in order to get into the hydrogen. The law is that the rate of traversing the plug is inversely proportional to the square root of the density of the gas; or, in terms of the kinetic theory of gases, it is directly proportional to the average velocity of the molecules of each gas. The rates at which gases will traverse a single small aperture ('effusion') are within the limits of experimental error, in accordance with the same law. The rates at which gases slowly pass under pressure through extremely fine long tubes, or are 'transpired,' have no relation to the diffusion or effusion rates; the mass of gas passing per second varies as the motive pressure, as the density, and inversely as the length of the tube, and also as a coefficient of transpiration special to each gas, and presenting from gas to gas certain coincidences as yet unexplained (see Graham's *Collected Works*, or Miller's *Chemical Physics*). The rate is slower the higher the temperature, but is independent of the material of the tube.

When gases are separated by membranes, in which they are unequally soluble, or for which they have unequal affinities, the diffusion-rates are interfered with and become abnormal—e.g. benzol-vapour and air separated by a thin india-rubber membrane; the benzol traverses, the air does not. Thus also carbonic oxide, an extremely poisonous gas, may traverse red-hot cast-iron, a fact to be kept in mind in reference to overheated stoves. This is due to solution of the gas in the solid, which behaves like a liquid film in reference to it. Gases are also condensed on the surface of solids; every solid object bears a condensed film of air on its surface; some substances have enormous power of condensation, notably cocoa-nut charcoal (Hunter), which absorbs 170 times its own volume of ammonia, 69 of carbonic acid, 44 of water-vapour. This power is beneficially utilised in charcoal respirators, in which oxygen and oxidisable gases are condensed together and combine; and in Döbereiner's hydrogen lamp, in which hydrogen plays upon platinum black, and is condensed so rapidly (perhaps being oxidised at the same time) that the platinum becomes incandescent and ignites the hydrogen jet.

The superficial film of air on solids plays a part in friction in air; a pendulum has the amplitude of its swing slightly diminished by this friction: a waterfall drags air down and is retarded by this frictional action; and the examples of railway trains and cannon-balls will readily occur. The slide-valve of a steam-engine is pressed upon by the steam, and this gives rise to friction.

Gases are in many cases soluble in liquids; some are greatly so (ammonia in water at 0° C., 1049·6 volumes; at 20° C., 654 volumes), some slightly (hydrogen in water at 0° C., 0·0193 volume). The general rule is (Henry's Law) that, at any given temperature, the volume of gas dissolved is constant at all pressures, so that the quantity of gas dissolved is proportional to the pressure; and on liberation from pressure some of the gas escapes. This law is interfered with in most cases by the formation of chemical compounds (hydrates) between the water and the gas dissolved. Again, when a mixture of gases is presented to a liquid, the general rule is that each is dissolved in proportion to the partial pressure exerted by it, combined with its own specific solubility in the liquid: thus the small quantity of air dissolved in water, which subserves the respiration of aquatic life, contains 34·82 per cent. of oxygen instead of 20·9 per cent., as air does, because oxygen is more soluble in water than nitrogen is. Where, however, the gases have a mutual chemical action, this rule is completely departed from. One effect of the formation of hydrates may be that the gas is not expellable by boiling: hydrochloric acid gas is an example: a certain excess of gas may be driven off by heat, but beyond that the aqueous solution of hydrochloric acid distils over as a whole: ammonia gas or carbonic acid, on the other hand, may be completely driven off from water, any feeble hydrates formed being decomposed. Gases may, it appears, dissolve gases; oxygen evolved from chlorate of potash may (Schützenberger) contain chlorine unrecognisable by any chemical test until a red heat has been applied; and it seems that there is no case of evaporation without the vapour carrying off some of the solids dissolved in the evaporating liquid, a phenomenon specially observed in the case of boracic acid solutions, and also in the case of coal-gas, which may, especially when rich in the vapour of liquid hydrocarbons, carry much solid naphthaline in a state of invisible suspension approximating to true solution.

Gases are to a certain extent viscous; air or steam in motion will drag the surrounding air along with it, and will thereby have its own motion checked. Wave-motion set up in air may travel far, but has at length its energy worn down into heat through the viscosity of the air. Air is at 0·6° C. about a hundred times less viscous than water is, and at 90° C. it is only about twelve times less viscous than water at that temperature. The viscosity of any given gas, dynamically measured, does not vary with its density.

Gases also possess a feeble power of conducting

heat by a kind of diffusion and redistribution of energy of heat-motion. In hydrogen a heated wire is very rapidly cooled; in a heavier gas, less rapidly so. The conductivity of air, when the heat conducted is reckoned in units such that each will raise a cubic cm. of the substance (air) itself through one degree Centigrade, is 0·256; under similar conditions that of iron is 0·183, and that of copper is 1·077; so that the rate of propagation of thermal effects in air is intermediate between that in iron and that in copper. This apparently high rate is due to the small density of air and to its low specific heat; and when we turn to the actual propagation of heat-energy as distinguished from that of temperature, we find the conductivity of air, in this sense, to be only about one 20,000th that of copper.

Gases have as a rule small specific heat: air has at constant pressure a specific heat = 0·2375, at constant volume 0·1684; that is, to raise a pound of air 1°, allowing it to expand, takes 0·2375 as much heat as it would take to raise a pound of water, whereas if it be not allowed to expand and thereby absorb energy, it will take only 0·1684 times as much. The specific heat of gases is stated in tables with reference to 'air = 0·2375' as a starting-point; an equal *volume* of hydrogen has a specific heat at constant pressure = 0·2359, and, roughly, equal volumes of all the ordinary gases have equal thermal capacities; but ordinary vapours have, volume for volume, much greater thermal capacities than ordinary gases. Hydrogen has a specific heat, weight for weight, 3·0490 times (at constant pressure) as great as water; and it is the solitary exception to the statement that water has of all substances the highest specific heat. In general the specific heat of a gas at constant pressure is about 1·4 times its specific heat at constant volume; in the latter case no heat is absorbed in doing the work of expansion against resistance. The specific heat of gases rises slightly with increasing temperature (Mallard and Le Châtelier), and this becomes at furnace heats very well marked: at 2000° C. the specific heats of carbonic acid and water-vapour are double, and those of nitrogen, oxygen, and carbonic oxide about one and a half times as great as what they are at 200° C.

Different gases have different actions upon radiant heat and light; they characteristically absorb special portions of the heat and light spectrum, and thus produce absorption bands: the dark lines A and B seen in the solar spectrum are traced by Egoroff and Khamantoff to the absorptive action of oxygen. In some gases the absorption is carried so far that the gas appears coloured—e.g. chlorine, which is yellowish-green: iodine vapour in comparatively thin layers allows only red and blue light to pass, and thus appears purple; in thicker layers only blue light passes. On the whole, however, gases are poor absorbents and correspondingly poor radiators: there is comparatively little radiation from a Bunsen flame. At the same time the radiation from an incandescent gas tends to be very precise in its frequencies; it tends to produce line-spectra as distinguished from the continuous spectrum produced by the mutually jolting particles of an incandescent solid. Each gas has its own index of refraction also; oxygen has, for example, as compared with vacuum, a mean index at atmospheric pressure of 1·000272. In vapours the dispersion is great; and iodine vapour strangely refracts red most and violet least.

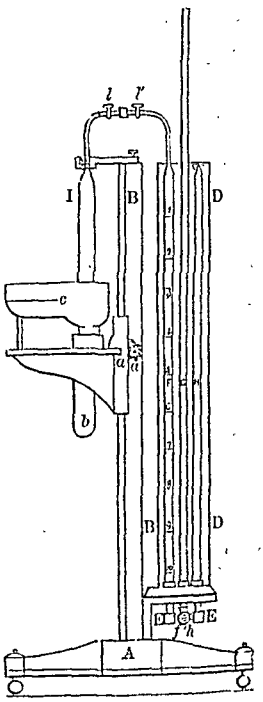
In Electricity (q.v.) the different gases have different properties which sometimes present curious anomalies; air at ordinary pressures is an insulator; warm air at rest is an insulator, but above a Bunsen burner it is a conductor; at low pressures it conducts and glows while conducting; at extremely low pressures it is again an insulator. Different gases set up different potential-differences between themselves and metals with which they may be in contact, as in gas-batteries, and they have different specific inductive capacities.—Oxygen is magnetic in the same sense as iron; hydrogen and nitrogen are diamagnetic, and tend to lay themselves across the poles of a magnet. See also MATTER (STATES OF).

ANALYSIS OF GASES.—The gas is collected in small glass vessels, the contents of which, consisting of mercury, water, or air, are displaced by the gas to be analysed. For the best methods of collecting gases from mineral springs and waters, from volcanic lakes, geysers, or boiling springs, from openings in rocks, clefts of glaciers, furnaces, fissures in volcanic craters, &c., reference may be made to Bunsen's *Gasometry*, translated by Roscoe. Air is only used when a considerable current of the gas to be analysed can be procured, which may sweep out the last traces of air from the collecting vessel. Water often affects the composition of mixed gases which it is attempted to collect over it; for to various extents it absorbs, among others, hydrochloric, hydriodic, hydrobromic, and sulphurous acid gases, chlorine, sulphuretted hydrogen, ammonia, fluoride and chloride of boron, methyl- and ethyl-amine, methyl chloride and methyl ether, cyanogen, and chlorine cyanide; and it decomposes silicon fluoride with precipitation of gelatinous silicic acid. Mercury is generally employed because it is inert to most gases; but it is attacked by chlorine, which it absorbs.

There are two leading principles made use of in the analysis of gases. First, a given volume is subjected to a chemical reaction, which results in the *condensation* of one of the constituents of the gaseous mixture or compound; then by simple observation, or from the known laws of gaseous volume, it is determined how great a volume of the original gas has disappeared through being amenable to the reaction employed, and, accordingly, how great a proportion of the constituent in question was originally present. In the case of air, for example, a measured volume may be exposed to the absorptive action of a strong alkaline solution of pyrogallol; the solution becomes dark; the oxygen is absorbed; the original volume of air is diminished; the loss of volume is ascertained, and represents the quantity of oxygen originally present in the measured volume of air. Or again, if the mixture of gases be a somewhat more complicated one, as, for example, a mixture of carbonic acid and oxide, olefiant gas, and oxygen, the various absorbent reagents appropriate to each constituent may be successively introduced, and the successive shrinkages noted by remeasurement at the original temperature and pressure. A few drops of a solution of caustic potash will in this way take up the carbonic acid; pyrogallol will take up the oxygen; anhydrous sulphuric acid dissolved in oil of vitriol, and introduced on a coke-pellet, will slowly take up the olefiant gas, and the sulphurous acid and anhydrous sulphuric acid vapour, which contaminate the gas after this reaction, may be removed by caustic potash; and carbonic oxide may be absorbed by means of a solution of cuprous chloride (prepared by leaving copper turnings with a saturated solution of cupric chloride in a stoppered bottle for some days), which will take it up in about ten minutes. The principal absorption reagents are (1) caustic potash solution, which absorbs sulphuretted hydrogen, hydrochloric, carbonic, sulphurous, and other acid gases, chloride and fluoride of boron, and chloride of cyanogen, and decomposes siliciuretted hydrogen with evolution of 4 volumes of hydrogen; (2) dry caustic potash, which acts like the solution, but more slowly, and also absorbs

water-vapour; (3) alcoholic solution of caustic potash, which also absorbs bisulphide of carbon; (4) alkalinised solution of pyrogallol—oxygen; (5) phosphorus—oxygen; (6) cuprous chloride dissolved in hydrochloric acid—oxygen, carbonic oxide, acetylene, and allylene; (7) the same dissolved in ammonia, which absorbs also the hydrocarbons of the olefine series; (8) dilute sulphuric acid—ammonia, methyl-amine, and other amines; (9) strong sulphuric acid—water, alcohol, methyl ether, propylene and its homologues; ethylene slowly, hydrogen and marsh gas not at all; (10) Nordhäusen sulphuric acid, which absorbs the olefines, not hydrogen or the marsh-gas series; (11) concentrated aqueous solution of sulphate of iron, which absorbs nitric oxide; (12) bromine, which in presence of water acts like Nordhäusen sulphuric acid; (13) sulphur, which absorbs sulphuretted hydrogen, sulphurous acid, and bisulphide of carbon; (14) chromous sulphate, to which ammonium chloride and ammonia have been added, absorbs oxygen, nitric oxide, acetylene, and allylene; (15) alcohol absorbs chloride of cyanogen, methyl chloride, methyl ether, and cyanogen; (16) mercuric oxide—cyanogen; (17) lead acetate—sulphuretted hydrogen; (18) lead peroxide—sulphurous acid. Analyses conducted by the aid of such reagents are direct; and on the same principle of observation of shrinkage we may also employ explosion-reactions. In the case of air we take a measured volume and add to it about half its bulk of hydrogen, observing precisely what volume we add. In this case the graduated tubular vessel, in which the gas is contained, has two platinum wires fused into it so as to approach one another within the vessel; our vessel is then called a Eudiometer. An electric spark is made to leap across the interval between the two wires; an explosion occurs; part of the hydrogen of the mixture combines with the whole of the oxygen; presently the aqueous vapour formed condenses, and the volume of the mixture becomes, at the former temperature and pressure, considerably less than it was before the explosion. The shrinkage is measured; the gas which has disappeared consisted, for every three volumes, of two of hydrogen and one of oxygen. One-third of the shrinkage, therefore, represents the amount of oxygen present in the air subjected to this process; and in the case of air the balance of the original volume is taken (if the air had been freed from moisture and carbonic acid) as consisting wholly of nitrogen. In more complicated mixtures the explosion-reactions lead to more complicated processes and calculations. For example, if we have a mixture of hydrogen, methane, carbonic oxide, and nitrogen (which corresponds to coal-gas that has been passed through potash solution and has stood over strong oil of vitriol), we first explode a known volume of the mixture with an excess of oxygen. The shrinkage is observed, and then potash solution is introduced in order to remove the carbonic acid formed by the combustion of the methane and the carbonic oxide. The nitrogen alone now remains, together with the excess of oxygen; and the amount of the latter is determined by another explosion with hydrogen, whence the amount of nitrogen may be determined; and from this we find the volume of combustible gas originally present in the mixture. We now know (1) the volume originally used (A); (2) the volume of combustible gas therein contained (B); (3) the contraction of volume on explosion (C); and (4) the volume of carbonic acid generated on explosion (D). We also know that when hydrogen is exploded with an excess of oxygen the combustion of one volume of hydrogen causes the condensation of $1\frac{1}{2}$ volume of the mixture; that the combustion of 1 volume of carbonic oxide similarly causes a shrinkage of $\frac{1}{2}$ volume, and the production of 1 volume of carbonic acid; and that the combustion of 1 volume of methane (light carburetted hydrogen, marsh-gas, CH_4) produces a shrinkage of 2 volumes and the formation of 1 volume of CO_2. Hence we find that the shrinkage C is made up of the original H-volume $\times 1\frac{1}{2}$, *plus* the CO-volume $\times \frac{1}{2}$, *plus* the CH_4-volume $\times 2$; and that the carbonic acid ($= D$) is equal to the CO-volume *plus* the CH_4 volume; and if we set down these statements algebraically, writing w for the original volume of nitrogen, x for that of hydrogen, y and z for those of carbonic oxide and marsh-gas, we have the equations $A = w + x + y + z$; $B = x + y + z$; $D = y + z$; and $C = \frac{3x}{2} + \frac{y}{2} + z$, from which w, x, y, z may be readily found and thereafter reduced to percentages. If any of these quantities, w, x, y, z, be found equal to 0 (or to a small negative quantity), the corresponding gas is not present in the mixture.

The apparatus made use of varies from a simple graduated tubular vessel to the more elaborate compensating apparatus now in use. The object of compensation is to enable the volume of the gas to be ascertained without calculation for correction. We may refer by way of illustration to the apparatus of Frankland and Ward, which is fully explained in Williams' *Handbook of Chemical Manipulation*, as well as in Messrs Frankland and Ward's memoir in the *Quarterly Journal of the Chemical Society*. We take as an example an explosion-analysis of atmospheric air. A few (three or four) cubic inches of air, freed from carbonic acid, having been introduced into the tube, I, it is transferred into F for measurement by opening the cocks, l, l', and placing the tube, F, in connection with the exit-pipe, h; the transference can be assisted, if necessary, by elevating the mercurial trough, C. (The part marked b in the figure is merely the tubular well of the mercurial trough, C.) When the air, followed by a few drops of mercury, has passed completely into F, the cock, l, is shut, and f turned, so as to connect F and H with h. Mercury is allowed to flow out until a vacuum of two or three inches in length is formed in H, and the *metal in F is just below* one of the graduated divisions; the cock, f, is then reversed, and mercury very gradually admitted from G, until the highest point in F exactly corresponds with one of the divisions upon that tube; we will assume it to be the sixth division, there being ten divisions in all. This adjustment of mercury, and the subsequent readings, can be very



A, a tripod, with levelling screws; BB, a vertical pillar, to which is attached C, a mercurial trough, movable by a rack and pinion, aa; DD, a glass cylinder, 36 inches long, with an internal diameter of 4 inches, containing three tubes, F, G, H, which communicate with one another, and with the exit-pipe, h, by the apparatus E f E. The rest of the figure will be sufficiently intelligible from the description given in the text.

accurately made by means of a small horizontal telescope, placed at a distance of about six feet, and sliding on a vertical rod. The height of the mercury in H must now be accurately determined; and if from the number thus read off the height of the sixth division above the zero of the scale in H is deducted (the scale on H is not marked in the figure), the remainder will express the true volume of the gas, no corrections being required for variations of temperature, atmospheric pressure, tension of aqueous vapour, &c.

Hydrogen, in the proportion of half the volume of the air used, must now be passed into I, and from thence into F, when the volume of the mixed gases must be again determined as before. An electric spark must now be passed through the mixed gases in F by means of the platinum wires at *m* (near the top of F). A slight explosion occurs, after which we observe a considerable contraction in the volume of the mixed gases, and one-third of this shrinkage represents the volume of oxygen. (For other instruments, see *Zeitschrift für analytische Chemie*, Bd. xxv. p. 467; *Berliner Chem. Berichte*, Bd. xx. p. 2340; *Journal für Gasbeleuchtung*, 1889, p. 3).

The objection to this kind of gas-analysis is its comparative slowness. When we wish to control the process of coal-gas-making, or the processes of combustion or decomposition occurring at various levels within a furnace, it is necessary to collect a series of specimens during the progress of the decomposition, but the results of gas-analysis are rarely available with useful expedition. Where it is sufficient to trace up one special constituent, such as sulphuretted hydrogen in coal-gas or carbonic acid in ventilation-experiments, results of considerable value may be attained by passing known volumes of the gas through a known quantity of a test-liquid, or shaking it up with it, and measuring by *titration* the amount of the reagent unaffected by the particular constituent of the gas; or, more rapidly, by the gradual addition of one to the other until the mutual reaction ceases. For instance, 100 cubic cm. of crude coal-gas may have successive instalments of a dilute solution of iodine of known strength brought into contact with it; when the reaction ceases the iodine solution ceases to be decolorised by the sulphuretted hydrogen, and if starch be present a blue tint will be struck. This method (*Dingler's Polytechn. Journal*, 1888, Bd. cclxix. p. 232) enables small quantities of gas to be dealt with, and small percentages to be estimated; and to a certain extent successive reagents may be applied for the estimation of different constituents.

Gas, Lighting and Heating. I. *Coal-gas* is produced by the simple distillation of dry coal. Anthracite coal is unsuited for this purpose; brown coal and lignite are unsatisfactory: the greatest yield of the best gas is obtained from highly bituminous coals, the disadvantage attendant on the use of which is that they are expensive and leave as residue an inferior or worthless coke, mainly ash; practically the most useful gas-coal is that which will, either alone or mixed with a certain proportion of bituminous coal, yield a fair quantity of good gas and leave good coke in the retorts. The very highly bituminous coals are only used for mixing with ordinary coal: the ordinary bituminous or cannel coals are largely used, especially in Scotland, for making richer gas of 25 to 30 candle-power (in standard burners burning 5 cubic feet per hour), and are usually mixed with ordinary coal with the view of improving the coke produced. The ordinary caking coals of the north of England are mainly used in England, mixed with a proportion of cannel or of highly bituminous coal or shale in order to improve the gas, which is generally supplied with an illuminating power of from 16 to 20 candles. The gas-coal used on the Continent is intermediate between caking coal and cherry coal, and gives gas of from 12 to 17 candles. By bituminous coal is not meant coal which actually contains bitumen, but coal which contains carbon and hydrogen in a proportion suited to the formation of heavy hydrocarbons when the coal is exposed to heat: no bitumen can be dissolved by alcohol out of a so-called bituminous coal. The proportions of hydrogen and oxygen to the carbon in various materials is shown in the following table:

	Carbon, per cent.	Hydrogen, per cent.	Oxygen, per cent.	Hydro. per 100 carb.	Oxy. per 100 carb.
French anthracite (Isère)	94	1·49	..	1·6	..
Glamorganshire anthracite	91·5	3·5	2·6	3·8	2·8
Average Newcastle gas-coal	82·1	5·3	5·7	6·4	6·9
Wigan cannel	79·2	6·1	7·2	7·7	9·1
Boghead mineral	63·93	8·86	4·70	13·8	7·4

The hydrocarbons which enable the gas to give a luminous flame depend for their formation upon the presence of hydrogen: oxygen, on the other hand, is detrimental; it takes up hydrogen to form water, and with carbon it forms carbonic acid and carbonic oxide. Hence we should expect considerable differences between the results of distillation of these substances. Anthracite gives no useful result; Newcastle gas-coal gives, per ton, a little over 10,000 cubic feet of gas, of an illuminating power ranging between 14 and 20 candles; Scotch cannel, 10,600 feet, of 30 candles; Scotch Boghead, distilled alone, 13,000 feet, of 40 candle, or 15,000 feet, of 35 candle; and Australian Boghead, 14,000 feet, of 50 candle-gas. These are given merely as typical examples; the results vary greatly according to the temperatures employed and the duration of the exposure to heat. Newcastle cannel coal, for example, if distilled between 750° and 800° F., yields, per ton, 68 gallons of crude oil (whereof may be recovered, paraffin spirit about 2 gallons; lamp-oil, 22½ gallons; heavy oil and paraffin, 24 gallons), 1280 lb. of coke, and only 1400 cubic feet of gas; whereas, when it is distilled for gas in the usual way, it yields, besides the coal-gas, 18½ gallons of coal-tar (wherefrom 3 pints benzol, 3 pints coal-tar naphtha, and 9 gallons of heavy oils, naphthaline, &c.), and 1200 lb. coke. Protracted distillation at high heats causes the evolution of hydrogen rather than of hydrocarbons; high heats in general cause the production of volatile rather than of condensable hydrocarbons, and this results, if not carried to excess, in a decided advantage—viz. that the gas produced, though of lower quality than the smaller quantity produced at low heats, is greatly less liable to lose its illuminating power by condensation and deposition of hydrocarbons on the way to the consumer. Very roughly, the candle-power is, within a limited range, inversely proportional to the number of feet of gas made (at a given temperature) from a given quantity of coal. Thus, if a ton of coal give 10,000 cubic feet of 15¾ candle-gas, then, if the distillation be protracted so that 10,500 feet are produced, the candle-power will sink to 15. According to Dr Tieftrunk, the percentage composition (in volumes) of the gas which comes off in successive hours may be represented as follows:

	1st hour.	2d hour.	3d hour.	4th hour.	5th hour.
Heavy hydrocarbons	13	12	12	7	..
Marsh-gas	82	72	58	56	20
Hydrogen	..	8·8	16	21·3	60
Carbonic oxide	3·2	1·9	12·3	11	10
Nitrogen	1·3	5·3	1·7	4·7	10
Relative volumes in successive hours	1	0·685	0·387	0·105	..

The distillation is thus after the fourth hour

practically disadvantageous to the illuminating power.

The products of distillation of coal, as usually performed in gas-works, are very numerous. The principal of them are marsh-gas, hydrogen, carbonic oxide, carbonic acid, nitrogen, oxygen, sulphuretted hydrogen, ammonia, hydrocyanic acid, bisulphide of carbon, and other organic sulphur compounds; aqueous vapour; ethylene, propylene, butylene, *acetylene*, *ditetryl*, and *allylene*; caproyl, capryl and rutyl hydrides; caproylene, œnanthylene; benzol, toluol, xylol, cymol; paraffin, naphthaline, anthracene, chrysene, pyrene; acetic acid, carbolic acid, cresol, phlorol, rosolic acid; aniline, pyridine, picolin, and several other nitrogenous alkaloid substances; with some hydrochloric and sulphurous acids. These substances have very different volatilities and solubilities; a large number of them may be separated from the gas by mere cooling, and together these form *coal-tar*, which is a black viscous liquid, sp. gr. 0·98 (from cannel) to 1·15 (from ordinary coal), the yield of which is, from coal, up to 12 gallons, and from cannel up to 17 gallons per ton distilled, the average yield being scarcely 11 gallons. By careful distillation coal-tar yields successively the following products, the percentages of which vary widely from the product of one gas-work to that of another: 2–4 per cent. of water, ammonia (which may be extracted from the tar by cold water), and volatile hydrocarbon vapours; 1·5 to 16 per cent. of light oils, including carbolic acid; 20–35 per cent. of heavy oils (creasote oils); 10–20 per cent. of anthracene oils, and a residue of 28–64 per cent. of pitch. The reason of this wide range of variation in the tar lies partly in the nature of the coal used, the temperature of distillation (the higher the heats the thicker the tars), and partly in the mode and temperature of condensation.

After the tar has been mostly deposited the gas is washed with water, which is converted into ammoniacal liquor, containing ammonia, carbonate of ammonium, sulphide of ammonium and some sulphite, chloride, and sulphocyanide of ammonium, and salts of nitrogenous alkaloids. After being cooled and washed the gas still contains carbonic acid, sulphuretted hydrogen, some hydrocyanic acid, and some bisulphide of carbon, and other sulphur compounds. Slaked lime, moistened so as to form a porous mass, will absorb the carbonic acid and sulphuretted hydrogen, but not the hydrocyanic acid and bisulphide of carbon so long as there is free carbonic acid present. Oxide of iron absorbs H_2S, becoming sulphide; and this, when re-exposed to the air, is reoxidised, the oxide being regenerated, while free sulphur is formed mixed with the oxide; the oxide may be used over and over until the percentage of free sulphur rises to 50 or 56, after which the oxide is 'spent,' and is transferred for the sake of its sulphur to the manufacturing chemist. Spent oxide also contains a valuable product—viz. Prussian blue, or ferrocyanide of iron, Fe_7Cy_{18}; this, together with sulphocyanide of iron, is formed from the hydrocyanic acid. Further, the free sulphur in the oxide arrests bisulphide of carbon and other sulphur compounds to a large extent. The regeneration of the oxide can be brought about, without raking it out *from time to time upon a floor and turning it* over, by admitting a percentage, say 2, of air into the gas-stream. The oxygen of the admitted air is taken up in continuous regeneration of the purifying oxide. The disadvantage of this is that the residual nitrogen of the air tells against the illuminating power of the gas; but recently, since pure oxygen has become cheap, oxygen gas alone has been employed with very favourable results. One result of continuous revivication is, that the evil smells associated with the opening of purifiers have become unfamiliar in most works. When continuous regeneration is resorted to, the oxide does not become spent until it contains a considerably higher percentage (as much as 75) of sulphur. Iron oxide, however, does not remove carbonic acid, and Mr R. H. Patterson showed that complete purification might be secured by removing (1) CO_2 by means of lime (the carbonic acid having a stronger affinity for lime than sulphuretted hydrogen has, is retained in the first lime purifier, while H_2S either passes on directly or is driven off by the succeeding CO_2 from any temporary lodgment it may have gained in the first purifier); (2) H_2S by a second lime purifier, the resulting sulphide of calcium uniting with the bisulphide of carbon to form thiocarbonate of calcium ($CaS + CS_2 = CaCS_3$, analogous to carbonate of calcium, $CaCO_3$), or rather a basic compound $CaCS_3, CaH_2O_2, 7H_2O$, and also with other sulphocarbon compounds; and (3) if necessary any remaining H_2S may be taken up by iron oxide. In 1888-89 Mr Valon found that if 0·6 per cent. of oxygen be added to crude gas, and if lime be used alone as the purifying agent, there is complete and simultaneous removal of the carbonic acid, sulphuretted hydrogen, and sulphide of carbon, the sulphur being separated in the free state and the gas-lime produced being entirely devoid of smell; while, owing to complete separation of the carbonic acid and through not introducing nitrogen, the lighting-power of the gas is at least 1¼ candle better than when iron oxide is employed alone.

The purified gas contains, in percentages by volume:

	London common Gas.	London Cannel Gas.	Boghead Gas.
Heavy hydrocarbons	3·8	13	24·5
Marsh-gas	39·5	50	58·4
Hydrogen	46	27·7	10·5
Carbonic oxide	7·5	6·8	6·6
Carbonic acid	0·7	0·1	..
Nitrogen	0·5	0·4	..
Aqueous vapour	2	2	...

The illuminating power depends on the 'heavy hydrocarbons;' of these benzol is the most effective (3 parts of it being equal to 25 of ethylene), and in ordinary English gas is present to the amount of from 5 to 10 grains per cubic foot, while ethylene and propylene are together from four to twelve times that quantity. If carbonic acid, sulphuretted hydrogen, and nitrogen be absent, the heavier gas is generally the richer, though a high percentage of carbonic oxide may also make a gas heavy. The specific gravity of coal-gas is from 0·4 to 0·55 (air = 1·00). There are two rough tests for the value of gas: (1) its durability—i.e. the time taken to burn 1 cubic foot of gas in a jet of 5 inches high; this ranges from 50′ 40″ for English caking coal-gas, to 84′ 22″ for Boghead gas; (2) the percentage of volume which is condensed by chlorine or bromine, which attack the heavy hydrocarbons. If any carbonic acid remain in the gas it will diminish the illuminating power about one candle for every 1 per cent. of carbonic acid. If gas be mixed with air the illuminating power rapidly falls off: with 1 per cent. of air, the loss of lighting-power is 6 per cent.; with 2, 11; 3, 18; 4, 26; 5, 33; 10, 67; 20, 93 per cent.; 45, total loss of lighting-power. Ordinary gas mixed with more than 4 and less than 12 times its bulk of air is explosive; most so when *mixed* with 8 volumes of air—or somewhat more (up to 11 volumes) if the gas be richer. Alone, it is not explosive. For ascertaining the illuminating power, the Bunsen photometer (the open 60-inch Bunsen-Letheby photometer, or the enclosed 100-inch Evans photometer) is generally employed. In this, at one end of a rod, there is a candle; at the other end there is a gas-burner, and a meter to measure the supply of gas; the gas-burner and the candle are thus at a

fixed distance from one another. Between them there moves, sliding on a graduated bar, a disc of prepared paper; this is slipped up and down until its two sides (or rather the images of its respective sides in two little mirrors which travel with it) appear equally illuminated. The bar may be graduated in one of two ways: (1) Equal intervals, so that the respective distances between the disc and the gas-burner and candle may be measured; then the ratio between the intensities is the inverse ratio of the *squares* of the respective distances; say, for example, that the respective distances of the candle and gas-burner are 20 inches and 80 inches; then the gas-burner's intensity: the candle's $::\left(\frac{1}{20}\right)^2:\left(\frac{1}{80}\right)^2$—i.e. ::16:1. (2) The bar may be so graduated as to anticipate and save this calculation, on which principle the mid-point of the bar would be marked 1, and a point one-fifth of the bar's length from either end would be marked 16; the figures so marked show directly the ratios sought for. The operation of photometry is a little troublesome (Schedule A, Gas-works Clauses Act, 1871); the pressure of gas must be measured by a gauge and regulated by a governor; the consumpt of the candle must be weighed; the gas used must be exactly 5 cubic feet per hour; the burner is a standard Sugg's London Argand No. 1 for common coal-gas, a standard Steatite Batswing burner for cannel gas; the candles are sperm candles, of six to the pound, each burning 120 grains per hour; and the quantity of gas used is to be corrected for temperature and barometric pressure. The candle is a very unsatisfactory unit of light; it varies as much as 6 per cent., and its colour is not the same as that of the gas-flame. Other standards have been proposed: of these the principal are the German standard candle = 1·023 English sperm candle; the French Carcel lamp (648 grains colza-oil per hour) = 7·435 English sperm candles; Mr Vernon Harcourt's pentane lamp, air + pentane-vapour, ½ cubic foot per hour, nearly equal to the English standard candle; Mr Methven's and Mr Fiddes's standard, in principle a given area of the bright part of any gas-flame, this being, singularly, an almost uniform standard of illumination; Herr von Hefner-Alteneck's amyl-acetate lamp, with the flame turned up to a height of 1·6 inch, almost exactly an English standard candle. Other photometers (Elster's, with movable standard light, &c.) have been proposed. Lowe and Sugg's jet-photometer depends on this, that assuming the height of the flame to be kept constant, the lighting-power of a jet is inversely proportional to the consumpt—or otherwise, that the consumpt being kept constant, the height of the jet-flame is directly proportional to the lighting-power. In Giroud's jet-photometer the height of the flame at constant pressure is taken as the measure of illuminating power; when the flame is about 6 inches high, a variation of about ⅛ inch corresponds to a variation of one-candle power, when the whole lighting-power is from 10 to 14 candles per 5 cubic feet.

The apparatus in use within a gas-work for the production, purification, and supply of coal-gas may be briefly described under the following heads: (1) The retort-house; (2) ascension and dip pipes; (3) hydraulic main; (4) tar-well; (5) condenser; (6) washer; (7) scrubber; (8) exhauster; (9) purifiers; (10) change-valves, connecting pipes, and by-passes; (11) station-meter house; (12) gas-holder; (13) governor.

The *Retort-house* contains the *benches* or sets of retorts in which the coal is distilled. The retorts were formerly small, and of cast-iron only; they are now generally larger and of fireclay; though the use of iron is again becoming familiar in cases where the last retort or two of a set are more easily heated if made of iron than when made of fireclay. Retorts are made round, oval, and D-shaped; the first of

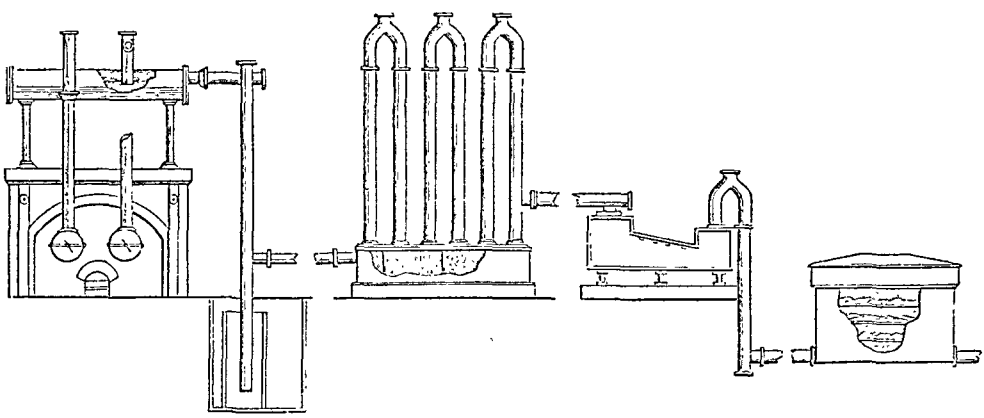


Fig. 1.—Elevation of Gas-works.

these is the strongest and most durable; the oval and the D-shaped are better carbonisers. Clay retorts are usually 2½ to 3 inches thick, oval, with diameters 15 and 21 inches inside, and 9 feet 4 inches long; but 'through' retorts are often used, corresponding to two ordinary retorts joined together so as to form one tube, some 18 feet long, with a mouthpiece at each end—a form which is more readily manipulated and more readily kept clear of coke-deposit. It has been pointed out that even these diameters are somewhat too great, and that the result is better with narrower retorts; and in small works smaller and shorter retorts are generally used. The Dinsmore retorts are Z-shaped, and the tarry products are subjected to continued distillation in the upper bends; a better yield of gas is said to be obtained. Five or seven retorts, and sometimes ten or more are built horizontally into each oven; and all the retorts of one oven are heated from the same source. This may be a coke furnace, in which case some 3¼ cwt. of coke are used in distilling each ton of coal—i.e. about 25 per cent. of the coke made—a proportion which sinks in large works to 20 or 18 per cent.—or tar may be used as fuel, either dropped on hot plates or blown in by air or by steam as spray; or generator

furnaces may be employed in which the fuel is first half-burned (CO being formed), and the hot furnace gases thus produced are burned under the retorts; or regenerative furnaces, in which the same thing is done, but the air which meets the furnace gases under the retorts is heated by the waste heat, which would otherwise have been allowed to escape through the flue after the retorts had been heated; the result being a great economy in fuel and in the wear of the retorts. The retorts, once heated up, are kept continuously at an orange-red heat (2000° F.); they are charged with coal (2½ to 3 cwt. each); the charge is raked out after three or four hours, and a fresh charge is put in; the charging and drawing being now often done by machinery. The duration of clay retorts depends on the treatment they receive; fifteen to eighteen months where directly exposed to the fire, or, where protected, three or four years, or even longer. Every retort is provided with a mouth-piece, through which the charge is put in and extracted, and the door of which is pressed home by a screw or lever and may or may not be secured by cement, according to the construction, while the gas is being produced; the gas produced passes from the retort by means of a wide vertical *ascending pipe* (2), a very short horizontal *bridge-pipe* and a short descending *dip-pipe*, which dips to a very slight extent below the overflow level of liquid in the *hydraulic main* (3). This hydraulic main is a wide tubular closed reservoir of wrought-iron, placed above the retorts; it has a large descending overflow-pipe; it is first filled with tar-water as far as it can be filled; the products of distillation from the retort pass through the hydraulic main; some tar is deposited, some watery liquid condensed; tar accumulates up to the overflow level, so that the gas passing through is washed in hot tar, and the light-giving constituents tend to become dissolved out to a large extent by the tar, unless the tar be kept sufficiently hot or be separately removed from the hydraulic main. Down the overflow-pipe run the products of distillation which sink into a *tar-well* (4), from which they are pumped out from time to time. This tar-well is also used as a general receptacle for condensation products deposited by the gas in its further course. The gas does not escape by this tar-well, for the overflow-pipe dips to an adequate depth into the liquid in the well; it passes on by a lateral horizontal tube. This device is repeated as often as it is necessary to withdraw condensation-products from the gas-stream.

The gas goes on to undergo a gradual process of cooling (to a temperature not below 55° F.) and farther condensation, partly in pipes led round the retort-house (in which the tar is largely deposited by friction while the gas is still hot), partly in the *condenser* (5). There are several types of condenser: (*a*) a series of vertical iron tubes in which the gas alternately ascends and descends, the cooling being due to the exterior air or to the trickling of water down the surface of the tubes; (*b*) vertical iron tubes of large size, concentrically arranged in pairs, so that the gas may slowly descend in the annular space between each two tubes, while the cooling air ascends the inner tube; the gas is then led up to the top of another annular space, and so on (Kirkham's); (*c*) a horizontal spiral; (*d*) arrangements for retarding the speed and thus enabling the gas, in comparative repose, more readily to deposit any particles; – battery condenser; Mohr's condenser, in which the gas is guided through hollow cones, so as to run slowly. The liquid deposited is conveyed by an overflow-pipe to the tar-well. The cooled gas is then led to the *washer* (6), in which it is passed in fine streams through water, which dissolves ammonia, &c.; but here or farther on, after the scrubber, there is a suction arrangement, either a fan, a pump, or a steam-jet injector, called the *exhauster* (8), which causes the gas to flow from the retorts through the successive pieces of apparatus. The coal being thus distilled in a partial vacuum, gas is more readily given off by it; and the gas once formed is rapidly removed from the retort and from the decomposing influence of the hot retort-walls, and its percentage in hydrocarbons is thus kept as high as may be. After the washer comes the *scrubber* (7), in which the gas is made to ascend a lofty column filled with coke or deal boards, down which water trickles, or is made to ascend a space filled with descending spray. Sometimes the gas is made, as in Pelouze and Audouin's so-called condenser, to deposit the last traces of tar by impact against solid surfaces; or may be made to run with or against a stream of hot tar, and thus to pick up hydrocarbons from the tar. Sometimes the functions of washer and scrubber are combined in one piece of apparatus; sometimes a scrubber is used alone. The gas next passes through the *purifiers* (9), in which it has to pass slowly up, or better down, through an ample extent of thick layers of porous lime, or of iron oxide somewhat moist and rendered porous by sawdust, chaff, or other vehicle, or aided by porous magnesia, or through both, or else through washed Weldon slime. The gas ought, before this stage, to be free from all impurities, except carbonic acid, sulphuretted hydrogen, and bisulphide of carbon, and these are removed in the purifiers. Various devices have also been introduced for absorbing these materials by means of ammonia and hydrocarbons separated in the earlier stages (Young, Claus, Hills). The British parliamentary standard of purity is that 10 cubic feet of gas shall not stain lead paper (absence of sulphuretted hydrogen); that the ammonia in the gas shall not exceed four grains per 100 cubic feet; and that the whole sulphur in the gas shall not exceed twenty-two grains per 100 cubic feet. The purifiers are so arranged that while a sufficient large area of purifying material shall always be encountered by the gas, one part of the purifiers after another is thrown out of action, and renewal of the material is thus possible, when required, without interruption to the purification. The *valves and connecting pipes* (10) are so arranged as to permit this alternation to be readily effected: and throughout the range of apparatus in a gas-work, the pipes are so arranged as to permit any single piece of apparatus to be cut out of the gas-stream when occasion requires.

The gas goes on from the purifiers to the *station-meter house*, in which there are (*a*) the station-meter, a large 'wet' meter for measuring the whole make of purified gas; (*b*) the exhaust, previously referred to; (*c*) pressure gauges, and (*d*) pressure-recording instruments; (*e*) the station-governor, by adjustment of which the pressure of gas as supplied from the gasholder to the mains is to be regulated; all these items being brought together into one place for convenience, the pipes within the works are arranged accordingly. From the station-meter the gas goes on to the *gasholder* (12), or holders, to be stored and issued as required. The gasholder is an inverted cylindrical vessel of sheet-iron, placed in a tank of stone, brick, concrete, cast or wrought iron, steel, or a combination of these, but generally of brick or stone, lined with Portland cement, or backed with clay puddle, and, where possible, sunk into the ground. The tank contains water, in which the cylindrical vessel floats and rises or sinks. As the floating holder rises and sinks, it is kept vertical by tall columns which surround it, and guide its

motion. On the tops of these columns are pulleys, over which run chains which at one end are connected to the crown of the gasholder, while at the other they bear suspended balance-weights. These balance-weights are not quite heavy enough to balance the weight of the floating vessel, which thus tends to descend and press the gas (contained between the water and the crown of the holder) out into the mains, and also back through the station-meter; but they so nearly poise the floating holder that the small pressure at which the gas is delivered through the station-meter is sufficient to lift the holder, and thus to enable gas to accumulate in it when there is no outflow through the main; and when there is such an outflow, the gasholder oscillates up and down according to the proportion between the gas taken off from the mains and that supplied from the retorts. When the diameter of a gasholder is proportionately great, it does not need counterbalancing. It is comparatively not a heavy structure, and it contains a gas which is lighter than air, so that the pressure upon the base, so far as due to the sheet-iron holder and its contents, readily comes to be but little more than that which would have been due to an equivalent quantity of air. Mechanical ingenuity has been spent upon framing the holder by means of ribs and internal bars, so as to give the maximum strength (freedom from buckling)

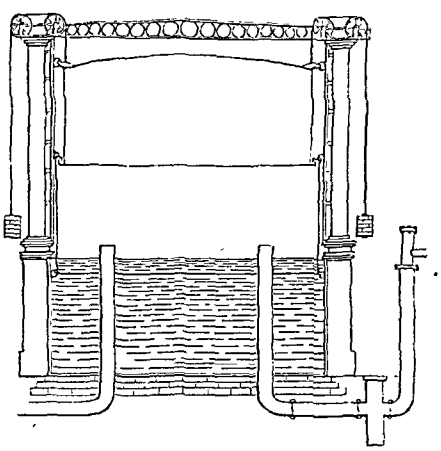


Fig. 2.—Section of Telescope Gasholder.

with the least weight; and upon the construction of telescopic holders, in which the holder is constructed in two, three, or four lifts or cylinders, of which only the inner one has a crown. In each pair of cylinders the inner one has its lower free edge turned up, so that when it rises it hooks into the down-turned upper free edge of the outer cylinder, and, as the gasholder goes on filling, lifts the outer cylinder from the tank, and so, if there be more than two lifts, for each succeeding cylinder; the gas being prevented from escaping between any two of these mobile cylinders by the water which the inner one lifts from the tank in its upturned edge. Recently the construction of the gasometer has been managed in such a way as to dispense with the columnar guides. Necessarily, the space within the gasholder above the tank-water is, by means of pipes, placed in communication both with the station-meter and the mains. The function of the gasholders is a most important one; they act as a reservoir and usually are of a capacity sufficient to contain a twenty-four hours maximum supply (the quantity used on a midwinter day); and they also equalise the pressure. The gasholder is the feature of gas-supply which ensures a regular supply at all hours both of day and night; and it is also conducive to economy, for a comparatively small plant, kept continuously working, is by its means enabled to meet demands for which, if the gas were supplied direct from the retorts, it would be quite inadequate.

Before reaching the mains the pressure of the gas is regulated by the *station-governor* (13); this is necessary, because an excessive pressure in the mains would result in excessive leakage. The governor has been the subject of several ingenious devices; the object of all is the same—viz. the automatic adjustment of resistance, whose amount is made to increase or diminish with the pressure; and this is accomplished either by the gas lifting to a greater or less degree the floating bell of a small gasholder, and thereby altering the position of a conical or parabolic plug suspended within the entrance to the main, or in some cases (Hunt's) by working a throttle-valve.

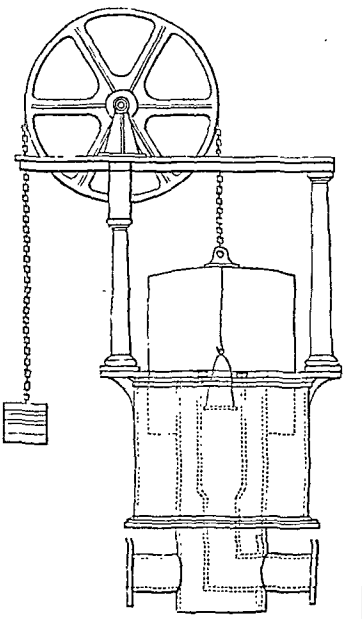


Fig. 3.—Section of Gas Governor.

The gas is conveyed from the works by main-pipes or *mains*, generally of cast-iron, carefully jointed; the jointing is effected either by turning and boring so as to make the pipes fit easily with a little white and red lead, or by using pipes which do not exactly fit, and making them do so by means of caulking, melted lead, india-rubber, or rust cement; in some cases the pipes are connected by ball-and-socket joints, and can then be paid out of a boat like a chain; in others, special provision is made for expansion. At each lowest point provision is made for taking off water, as by a trapped drip-well, the liquid in which can be pumped out into a cart and taken to the gas-works. When mains supply a district the altitudes in which vary considerably, the tendency is for the local pressures to vary correspondingly; a difference of *100* feet in level makes a difference of 1·5 inch of water in a pressure-gauge; and therefore it is necessary to use district-governors which control the pressure in particular districts. To the mains are connected branch or *service pipes*, usually of wrought-iron or lead, in which the possible deposition of moisture must be provided for, either by making the whole service-pipe drain into the main, or by fitting up a drip-well at each lowest point.

The gas supplied is measured by meters, of which there are two main varieties, the wet and the dry. The wet meter is a device for measuring out successive units of volume of gas; the reading will be the same whether the gas be delivered at low or at high pressures; and therefore the lower the pressure the less the absolute quantity of material in gas measured through a wet meter, and *vice versâ*. In a wet meter there

is a cylinder mounted on an axis; this cylinder is hollow, the hollow being divided into four parts or chambers by partitions, the longitudinal boundaries of which present the form of an Archimedean screw or the rifling of a gun; the gas enters one of these spiral chambers at one end; as the gas is pressed in, it displaces water and makes the hollow space lighter than water; it thus makes the hollow tend to rise, and in that way works the cylinder partly round. No gas can pass through the chamber until it is completely full. When one chamber has been completely filled, two things happen: the entering stream of gas now finds an inlet into the succeeding chamber; and, secondly, the gas in the first chamber finds a possible outlet at its opposite end, through a slit which now begins to emerge above water-level. As the cylinder goes on rotating, the first chamber comes to sink under water; water enters the chamber and gas leaves it; and so for each of the four chambers in succession. The axle, thus made to rotate in proportion to the amount of gas delivered, works a train of wheelwork which by means of pointers shows the number of 10,000's, the number of 1000's, and the number of 100's of cubic feet of gas which have passed through the cylinder. The water must be kept at a constant level; it may freeze, for which reason the meter should be kept in a sufficiently warm place (not too warm, else the gas will expand and the meter give too high a reading), or else a non-freezing liquid should be used; and the water damps the gas. Mechanical contrivances have been added to the wet meter in order to maintain the water-level constant; the meter sometimes shuts off the gas when the water is too low. Thus there may be an automatic addition of water from a subsidiary reservoir, or an automatic maintenance of level by a hinged float which sinks into the water when liquid fails to support it in its uppermost position (as in the constant-level inkstands); or, there may be (Warner and Cowan) a contrivance for transferring the excess of gas delivered at each revolution, when the water is too low, back again for measurement. When the meter is driven too fast the record is too low; but backwash in the meter then causes flickering at the jet; and the general use of meters too small for the work which they have to do is conducive to leakage in the district within which they abound, on account of the high pressure necessary to force gas through them.

Dry meters are, in principle, a variety of piston-meter; the fluid is measured by displacing a piston or diaphragm, and thereby filling a measured cavity. They consist of two or three separate chambers; each chamber is divided into two by a diaphragm, which may be displaced to one side or the other. The gas is admitted to the one side of this diaphragm until it is displaced to the full extent of its range; when this occurs the gas is admitted to its other side, and the gas previously admitted is allowed to go on to the burner, and so on alternately. The chambers act alternately, thus passing the dead-points. The diaphragms are connected with wheelwork which record their successive oscillations, and represent on the dials the corresponding number of cubic feet passed through the apparatus. By a British Act of Parliament (the Sales of Gas Act, 1859) all gas-meters must register not more than 2 per cent. in favour of the seller and not more than 3 per cent. in favour of the purchaser of gas; and meters must bear the seal of an inspector appointed under the act. Meters have recently been introduced which enable the poorer consumer to purchase gas by pennyworths on the familiar 'penny in a slit' principle. In Brussels the gas burned by day and that used at night are registered on different dials of the same meter.

It is of great importance that in the first place gasfittings should be adequate to supply the maximum demand for gas; and in the second, that the gas should emerge from each burner under a low pressure. If the gasfittings—pipes, &c.—be inadequate, as they mostly are, full flames cannot be produced, and the light is unsatisfactory; if, on the other hand, the full pressure of the mains is communicated too directly to the gas-burners themselves, there is a tendency to flare. This can be mitigated by partially turning off at the meter; but even then the variable demand may result in variable pressures at the burners. There should be a governor for each gas-burner, or for each small group of gas-burners; these are now readily procurable, and when they are used a full flame is obtained which is constantly and steadily kept up by a comparatively slow supply of gas; the incandescent particles or heavy heated hydrocarbon vapours upon which luminosity depends are allowed to remain as long as possible in the flame, and the gas is thoroughly burned; and air is not swirled into the interior of the flame by the swift current of gas, thus spoiling the luminosity. An ordinary burner gives greatly superior results when governed; and of late years, since the electric light has caused more attention to be paid to the efficient burning of gas, the burners themselves have been greatly improved; but burners should always be selected with reference to the quality of gas to be used in them.

The ordinary ratstail burner has long given place to the batswing and fishtail burners, the former of which are made with a clean slit across the head of the burner; the latter have two passages converging towards one another, the result being that the two streams of gas meet one another and spread out into a flat sheet of flame. The former use much gas at ordinary pressures, and a very small pressure ($\frac{1}{2}$-inch of water just below the burner) is sufficient to bring out the full lighting-power. In hollow-top burners the pressure is relieved by the gas swirling in a cavity below the outlet-slit. Burners of these classes should always be selected with steatite tops; metal burners soon rust and spoil the flame. In Argand burners the gas issues through a ring of holes; the flame is tubular, and is surrounded by a chimney; air ascends both inside and outside the tubular flame. In Dumas burners the circle of holes is replaced by a circular slit, and a regulator controls the admission of air. These various burners have also been collected in groups to form the so-called sunlights, and so forth; but the recent remarkable progress in gas-lighting has been due to the study of the mutual actions of flames, and to the use of hot air and sometimes hot gas. For example, we have concentric Argand flames (Sugg); porcelain cylinders in the axis of an Argand flame to keep the flame from flickering, to keep up the heat of the flame and also themselves to radiate light when incandescent; burners in which gas from a circular slit plays on the under surface of a porcelain globe; and especially regenerative burners of various models, generally with inverted flames, in which the heated products of combustion as they ascend are made to heat the incoming air which is on its way to feed the flame. The latest of these models is said to give a light exceeding 270 candles for an hourly consumpt of 13 cubic feet of gas. The use of globes and shades cuts off a good deal of light; a clear glass globe cuts off from 9 to 12 per cent.; ground glass about 40; opal globes about 60. Globes should never have a lower aperture narrower than 4 or 5 inches; the ordinary narrow aperture makes a strong draught of air, which materially weakens the brightness of the flame and unsteadies it. Other devices have also been adopted for using gas for lighting; the gas is burned with air in a small

Bunsen burner, and over the flame is fitted a basket of platinum wire (Lewis), or a small hood consisting of the oxide of didymium and others of the alkaline earths (Auer von Welsbach), which emit a brilliant white light on incandescence; or the ordinary flame of gas may be rendered more luminous by passing the gas over melted naphthaline, which it takes up (Albo-carbon).

For heating purposes coal-gas is now largely employed: mixed with air it produces a smokeless flame and a higher temperature when burned than it does when burned in luminous flames; and so for direct heating the Bunsen burner principle is suitable. But gas produces the same quantity of heat, provided that it is completely burned, in whatever way it is burned. Convenience, their superior cleanliness, may often determine the use of Bunsen flames; but where radiation is expected to come into play, the luminous flame is more effective; hence, for cooking, direct radiation from luminous flames is often preferred (see STOVES). Coal-gas as a fuel for ordinary cooking has the advantage of economy, in so far that it can be turned off when not wanted, and turned on at once; and it is smokeless if properly burned. Of course it ought not to be left unprovided with a chimney, any more than a coal fire, for the products of combustion would otherwise escape into the room. Gas is used to an increasing extent for ventilation; a well-arranged system of lamps, especially of the regenerative type, will provide the motive-power for carrying away their own products of combustion and, concurrently, for renewing the air of the room. Gas is also now largely used for Gas-engines (q.v.), which are now made up to 100 horse-power. The price of light obtained from coal-gas, as compared with the price of other illuminants, may be ascertained by finding the cost of a *candle-hour*—the light of one standard sperm candle for one hour—in each case. The following table combines the data of Stevenson Macadam, Letheby, Thompson, Poris, and others:

	Price per Candle-hour, in thousandths of a penny.
Edinburgh gas, 28 candle-power, in a 5-feet burner (No. 5); lighting effect = 28 candles; price of gas 3s. 6d. per thousand cubic feet	7·5
Do. in a 4-feet burner (No. 4); lighting effect = 20·3 candles	8·0
Do. 3-feet burner (No. 3); 13·8 candles	9·0
Do. 2 " (No. 2); 7·8 "	10·8
Do. 1 " (No. 1); 3 "	14·0
Do. ½ " (No. ½); 1 "	21·0
Gas at a price equivalent to the Edinburgh price, say 2s. for 16-candle gas; burned in Argands	5·6
Do. burned in Siemens' precision burner	4·7
Do. " 'Caloric' lamp	3·8
Do. " Schulke's lamp	2·0–2·6
Do. " Inverted Siemens, Buschke and Wenham	1·9–2·5
Glasgow gas, at 2s. 6d., in Lucient lamps	1·45
Sperm oil, at 2s. per gallon, in Argands	8·7–27·5
" " in common lamps	55·0
Paraffin, at 8d. per gallon, in *modern lamps*	5·3–8·9
Tallow candles, at 6d. per lb.	110
Composite candles, at 8d. "	160
Paraffin candles, at 6d. "	75
Wax candles, at 2s. "	404
Electricity in arc lamps, consuming 500 watts per hour	2·6
Electricity in *glow lamps*, 16 candle-power each, consuming 64 watts per hour, at 8d. per 1000 watts	32

The prices in this table are subject to correction for each locality, because the price of gas varies from place to place, as also does the quality. These variations are due to differences in the price of coal, the cost of the works, and so forth. To give an idea of the distribution of the cost of gas-making, the London Gas-light and Coke Company's accounts may be referred to. There we find the gross cost of manufacture of each 1000 cubic feet of gas sold is 22·531 pence; the residuals—coke, breeze, tar, and ammoniacal liquor—return 10·820d. of this; so the net current cost of manufacture at the works is 11·711d. for each 1000 cubic feet ultimately sold; the current cost of distribution is 1·776d.; public lighting involves an outlay of 0·400d.; rates and taxes come to 2·190d.; management to 0·801d.; various charges, including bad debts, annuities, testing stations, legal expenses, &c., come to 0·565d.—altogether 17·443d.; which meter rents (0·758) and miscellaneous receipts for work done, &c. (0·115), bring down to 16·570d. The average price of the gas sold is 30·345d.; the difference, 13·775d. per thousand on a sale of 9,063,735,000 cubic feet in six months, corresponds to a gross profit of just over 10 per cent. per annum on the paid-up capital of £10,289,000. The capital value of the works of this company in July 1889 was £10,342,000, 11s. 7d.; that of the South Metropolitan Company was £2,690,553, 3s. 6d.; and that of the Commercial Company, £808,398, 4s. 1d.

The risks of gas-lighting are twofold—explosion and poisoning. Explosion cannot occur until there is about 6·6 per cent. of gas in the air, but it is dangerous to 'look for a leak with a light.' As to poisoning, the gas must escape into a room without being noticed until there is about one-half per cent. of carbonic oxide—i.e. from 4 to 12 per cent. of coal-gas—in the air of the room, before danger to life becomes imminent; and this percentage is rarely attained by ordinary escapes into rooms of fair size. Fatal accidents have generally happened from escapes into small rooms, and also from the travelling of gas from broken mains through earth into an earth-floored house, which, being warm, may act as a chimney and draw the earth-gases through it in a deodorised condition. This last has occurred more frequently on the Continent than in Great Britain. A gas-escape is most likely to be serious in its consequences when it takes place into the upper part of a room; the percentage near the ceiling may then come to be much greater than it is at first lower down (see POISONS).

From 1639 onwards the attention of scientific men had repeatedly been turned to 'burning springs' or streams of 'inflammable air' issuing from wells and mines in the coal districts of England, and communications on the subject were addressed to the Royal Society of London. Some time before 1691, the Rev. Dr John Clayton, Dean of Kildare, addressed a letter to the Hon. Robert Boyle, in which he described experiments on the production and storage of inflammable gas distilled from coal; and this letter was published in the Royal Society's Transactions for 1739. In 1787 Lord Dundonald made some domestic experiments on lighting by coal-gas. In 1792 William Murdoch lit up his house and office at Redruth in Cornwall; in 1798 he lit up a part of Boulton & Watt's manufactory at Soho, Birmingham; and in 1805, with 1000 burners, the mills of Messrs Phillips & Lee at Salford. In 1801 Le Bon lit his house with coal-gas, and in 1802 he proposed to light a part of the city of Paris. In 1803 Wintzer or Winsor lectured in London upon the new light; he was a sanguine projector, holding forth fantastic hopes, but was instrumental in founding the Chartered Gas Company which obtained its Act of Parliament in 1810. In 1813 he was replaced by Mr Samuel Clegg, who had been managing Boulton & Watt's gas-lighting since 1805 in succession to Mr Murdoch, and who was the inventor of the hydraulic main, the wet meter, and the wet-lime purifier. In 1813 Westminster Bridge was lighted by gas, and immediately thereafter the new method of lighting made very rapid progress, not only in London, but throughout Great Britain and other countries; and in the contest for supremacy between coal-gas and oil, wood, and peat gas, which were at one time somewhat extensively tried, coal-gas took the leading place, to the

exclusion of its competitors. In most important places in the United Kingdom, the gas-works have been acquired by the local authorities on behalf of the public, few of the larger gas-works being left in the hands of gas companies.

The leading work on coal-gas is that of King, edited by Newbigging, whose *Gas Managers' Handbook* is also full of valuable detail; Wanklyn's *Gas Engineer's Chemical Manual*, for chemistry; and for
and the *Gas World Yearly A*
and Corporations' Accounts.

II. *Oil-gas* is prepared from heavy mineral oils (sp. gr. = 0·9) or paraffins, and from the residues from the distillation of these, and in some cases from spent grease, from suint, &c. In Australia it is made from waste mutton fat. One hundred lb. of oil yield from 722 to 1092 cubic feet of gas, of which *one* cubic foot per hour yields a light of 10 to 12 candles. The oil is made to flow in a thin steady stream into cast-iron retorts, heated to between 900° and 1000° C.; these retorts are horizontal or vertical, or are in some cases so arranged that gas formed in one retort or section of a retort is further heated in another retort or in another section of the same retort. The condensation of oil-gas requires special attention; oil-gas has a tendency to carry non-permanent vapours with it, and these must be removed. The purification of oil-gas necessitates the use of scrubbers, purifiers, and so on, as in coal-gas. In respect of the sulphuretted hydrogen it may be incidentally noted that Mr Bell has shown that even in refined paraffin and petroleum oils there is sulphur present often far in excess of that contained in an equivalent quantity of coal-gas. Oil-gas must be burned at a low pressure and in small burners; the standard burner is No. 1 (1 cubic foot per hour). Oil-gas is used for lighting railway carriages; the gas, carefully purified, is compressed at 10 atmospheres' pressure; it is then transferred to the reservoirs borne by the railway carriage, each of which carries, at 6 atmospheres' pressure, enough gas for 33 to 40 hours' lighting; a regulator governs the pressure at the burners, and each burner, consuming 0·777 cubic feet per hour, gives 7 candle-light. Compressed oil-gas has also been applied to the lighting of buoys, and to some extent to steam-ship lighting.

III. *Peat-gas* and IV. *Wood-gas* are occasionally used. Wood-gas is a by-product in the preparation of pyroligneous (crude acetic) acid; its lighting-power is about 20 candles; the yield is 546 to 642 cubic feet per 1000 lb. of wood; of the crude gas, 20 to 25 per cent. consist of carbonic acid. Peat yields 320 to 500 cubic feet of gas per 100 lb.; lighting-power about 18 candles; the carbonic acid in the crude gas is about 30 per cent.

V. *Producer Gas.*—When a limited stream of air is driven through glowing coke, the coke is first burned to carbonic acid; the carbonic acid, as it travels through the remainder of the brightly glowing coke, takes up carbon and, for the most part, becomes carbonic oxide; the resultant gaseous mixture consists of carbonic oxide (about 26 per cent.), the nitrogen of the air employed (about 70 per cent.), and some undecomposed carbonic acid (about 4 per cent.). This mixture is combustible with a clean flame, and this kind of fuel is now largely employed (generally with utilisation of the waste heat to warm the incoming current of air, as in the so-called regenerative furnaces) for heating the retorts in coal-gas-making, in metallurgical operations, in glass and pottery making, and in boiler firing. The furnace hearth becomes a clear, clean, deoxidising region of intense heat without visible flame. The gas from the producer is very hot; if it be passed at once into the furnace, a large proportion of the heat of the coke may be utilised; if it be allowed to cool, a considerable percentage is lost. The usual yield of producer gas is from coal (Siemens) about 160,000, from coke about 175,000 cubic feet per ton; the heating values are, for cooled gas, respectively 29,700 and 26,900 calories per thousand cubic feet, or altogether 60 and 68 per cent. of those of the respective materials employed.

VI. *Producer Water-gas.*—When mixed air and steam are driven through glowing coke (or anthracite, Dowson), the air keeps the coke glowing, and, as in the previous case, produces carbonic oxide, carbonic acid, and nitrogen; the steam acts on the glowing coke and produces hydrogen and carbonic oxide; the result is a mixture whose composition varies according to the relative quantities of air and steam, and according to the temperature in the producer; as an average it may be said to consist of 9 per cent. of carbonic acid, 24 of carbonic oxide, 13 of hydrogen, and 54 of nitrogen. If an excess of steam be used, there is more hydrogen, more carbonic acid, and less carbonic oxide. The usual yield is about 168,000 cubic feet per ton of material; the heating value is about 33,500 calories per 1000 cubic feet; altogether about 80 per cent. of that of the coke and anthracite employed. This process is continuous.

VII. *Water-gas.*—In 1793 Lavoisier discovered that when steam, unmixed with air, is passed through glowing coke, the coke is oxidised; carbonic oxide and hydrogen gas are produced, theoretically pure and in equal volumes; practically, the product contains 3 to 7 per cent. of carbonic acid, and 4 to 9 of nitrogen. The yield is from coke (7,000,000 calories per ton) about 35,000 cubic feet, with a heating value of about 75,000 calories per 1000 cubic feet, or on the whole about 40 per cent. of the heat-value of the coke; from coal (7,800,000 calories per ton) about 42,000 cubic feet, at 92,000 calories, or about 49 per cent. In the process the steam cools down the glowing coke; consequently air must be sent through the coke at intervals (about 4 minutes steam and 10 minutes air) in order to restore its glow; and a series of producers must be so conjoined as to act alternately with one another, before the process can result in a continuous supply of water-gas. The by-product, producer gas, which may be produced in large quantities (110,000 cubic feet, at 26,900 calories per 1000) by regulating the supply of air while the coke-glow is being worked up, may be used for boilers or for gas-engines. When it is so utilised, the net cost of making simple water-gas is between 5d. and 6d. per 1000 cubic feet, about 6d. per 1000 less than coal-gas. Water-gas gives on combustion an extremely high temperature, which saves time in furnace work; gold, silver, and copper, and even an alloy of 70 parts of gold and 30 of platinum are readily melted in quantity by it; hence for bringing objects such as Fahnehjelm's combs (a series of rods of magnesia) into brilliant luminous incandescence, for welding, or for metallurgical operations involving high temperatures, it is very suitable; and in gas-engines it works cleanly. When water-gas is used with Fahnehjelm combs, the quantity of gas used is (Dr F. Fischer) 180 litres, or 6½ cubic feet per hour, the light being, when the burner is new, 22 to 24 candles, and after 60 hours, reduced to 16. The combs (15s. per hundred) require renewal after 100 hours' use. As a carrier of heat, coal-gas is twice as effective in respect of quantity of heat; its heating-power is about 150,000 calories per 1000 cubic feet, which represents about 20 per cent. of the whole heat of the coal distilled, or about 50 per cent. after allowing for the heating-power retained in the coke, breeze, and tar; and this concentration of heating-power in smaller bulk may in some cases transfer the advantage of cheapness, through smaller cost

of distribution, to coal-gas. Water-gas is much used in the United States. It is supplied to houses, either pure or mixed with the coal-gas produced in the manufacture of the coke from which the water-gas is made, and it is then known as 'fuel-gas;' but more generally it is carburetted by being exposed to a high temperature along with naphtha or petroleum vapours, and the resultant mixture is employed as illuminating gas. Unfortunately the high percentage of carbonic oxide, which is odourless, has caused the death-roll due to water-gas to be a very high one in America. In New York, Brooklyn, and Baltimore the average yearly number of deaths from gas-poisoning before water-gas came in was 1·2; since then it has been 16, even though in these towns the gas is provided with a heavy carburetted smell.

VIII. *Natural Gas.*—This issues from the earth in many places—the immortal fires at Baku (q.v.), for example; gas-wells in other parts of the Caucasus, both natural and opened up in the course of boring for oil; some in China which are said to have been utilised; but principally in North America. At Fredonia, New York state, gas escaping from the earth has been used to a small extent since 1821. In 1859 boring for oil in Pennsylvania and elsewhere became general; the gas associated with the oil was looked upon as a disadvantage, and was conveyed to a safe distance and there burned. The general utilisation of the gas began in 1872 at Fairview, Butler county, Pennsylvania. Many of the gas-wells lasted only four or five years; some then sunk are still in action. In 1874 the gas was first used in iron-smelting and puddling by Spang, Chalfant, & Co., whose example was followed by the Pittsburg ironmasters about 1883. One company uses a million cubic feet per hour in smelting; another uses gas equivalent to 400 tons of coal a day; and to some places the gas is carried 60 or 70 miles by pipes. Pittsburg happens to lie in the centre of a gas area, and the result is, not to speak of the financial results, that Pittsburg, formerly lying under a continuous black pall of smoke, is bright and clear, and peaches now ripen in its gardens. Natural gas is also found, mostly by boring, in other districts in Pennsylvania, in Ohio, Indiana, Kentucky, Illinois, Kansas, Dakota, and at Los Angeles in California. The amount of gas used in the United States in 1888 was considered to have taken the place of 14,163,830 tons of coal (valued at $12,543,830); of the total, natural gas equal as fuel to 12,543,830 tons of coal was consumed in Pennsylvania. The North American gas consists mainly of marsh-gas; sometimes it contains nothing else than marsh-gas and a little carbonic acid; sometimes there are various percentages of hydrogen, ethylene, traces of carbonic oxide, nitrogen, oxygen, or heavy hydrocarbons. The Baku gas contains 3 per cent. of heavy hydrocarbons, and is more regularly deficient in hydrogen. The American gas is used for all metallurgical processes except the blast-furnace, and it is found very convenient for glass-making. In some towns where luminous natural gas is available, the public lighting is carried on, for the sake of economy, both day and night; in other places the gas is carburetted or used with Fahnehjelm's combs. In 1889 the supply was said to be showing signs of exhaustion; whatever be its duration it will have given an enormous impetus to the practical use of gaseous fuel and to smokeless firing. Natural gas may possibly underlie the English salt-beds.

Gascoigne, SIR WILLIAM, an English judge, born perhaps as early as 1340, was appointed, on the accession of Henry IV., a justice in the Court of Common Pleas, and in November 1400 was raised to be Chief-justice of the King's Bench. He was evidently a fearless and independent judge, as he refused to obey the king's command to sentence to death Archbishop Scrope and Mowbray, the Earl Marshal, after the northern insurrection in 1405; maintaining that the former was not subject to any civil tribunal whatever, while the latter had the right to be tried by his peers. Nine days after the death of Henry IV. a successor was appointed to his office, which effectually disposes of the ancient fiction that the young king Henry V. continued him in it, as expressed in splendid lines by Shakespeare in the second part of *Henry IV.* (V. ii. 102–121). Gascoigne died in 1419. His name will always live in the famous story of his encounter with the dissolute young prince Hal. Unfortunately it lacks historical support, there being no record of the story in the Controlment Rolls of the King's Bench, while Mr H. H. S. Croft and Mr F. Solly Flood believe it an anachronism originating in the misapplication of the entry on the Rolls of 33 and 34 Edward I., according to which the dissolute young prince, afterwards Edward II., had been expelled from the court for half a year, for an insult offered to one of his father's ministers. The story, as ascribed to Prince Hal, first appears in *The Boke named the Governour* (Book II. chap. vi.) of Sir Thomas Elyot, first printed in 1531. The prince, hot with anger at the arrest and arraignment for felony of one of his servants, burst into court, and when commanded to retire, came furiously up to the bench as if to slay or strike the judge, who, without moving, committed him to prison. The young prince, at once brought to his senses by the calm gravity and courage of the judge, submitted; and the king, when he heard of it, exclaimed: 'O merciful God, how much am I, above all other men, bound to your infinite goodness; specially for that ye have given me a judge who feareth not to minister justice, and also a son who can suffer semblably and obey justice.' Hall, actually a contemporary of Elyot, has the story also, and after him Holinshed, although none of the three, like Shakespeare, mentions the judge by name. Mr Croft concludes that the story may have been transcribed from the MS. of some unknown chronicler, most probably a monk, who was well content to narrate any story to the credit of a judge who had vindicated the privileges of the clergy, and of a king like Henry V. who had heaped the church with substantial benefits.

See vol. ii. (pp. 60–72) of Mr H. H. S. Croft's edition of Elyot's *Boke named the Governour* (2 vols. 1880), and chap. iii. of Rev. A. J. Church's *Henry V.* (1889).

Gasconade, a river of Missouri, winding 200 miles north-eastward through a hilly and picturesque country, till it joins the Missouri River, 35 miles below Jefferson city.

Gascony (Lat. *Vasconia*), an ancient district in south-western France, situated between the Bay of Biscay, the river Garonne, and the Western Pyrenees, and now included in the departments of Landes, Gers, Hautes-Pyrénées, and the southern portions of Haute-Garonne, Tarn-et-Garonne, and Lot-et-Garonne. Its subdivisions were a number of smaller districts, of which the best known were Les Landes (chief place, Dax) and Labourd (Bayonne). The total area of Gascony is over 10,000 sq. m.; its inhabitants, numbering about a million, have preserved not only their dialect and customs, but even their distinct individuality alike in outward aspect and in their good-natured temper. The Gascon is little in stature and thin, but strong and lithe in frame, with fine eyes and high colour. He is ambitious and enterprising, but passionate and given to boasting and exaggeration. Hence the name *Gasconade* has gone into literature as a synonym for harmless vapouring. The Gascons, moreover, are quick-witted, cheerful, and

persevering, and make capital soldiers. This is especially true of the Gascons in the Gers department; the peasants of the Landes, living in mud-huts, are extremely ignorant and rude in their manners, but yet are honest and moral.

Gascony derived its name from the Basques or Vasques, who, driven by the Visigoths from their own territories on the southern slope of the Western Pyrenees, crossed to the northern side of that mountain-range in the middle of the 6th century, and settled in the former Roman district of *Novempopulana*. In 602, after an obstinate resistance, the Basques were forced to submit to the Franks. They now passed under the sovereignty of the dukes of Aquitania (q.v.), who for a time were independent of the crown, but were afterwards conquered by King Pepin, and later by Charlemagne. Subsequently Gascony became incorporated with Aquitaine, and shared its fortunes.

See Monlezun, *Histoire de la Gascogne* (6 vols. Auch, 1846-50); Cénac-Moncaut, *Littérature populaire de la Gascogne* (Paris, 1868); and J. F. Bladé, *Contes populaires de la Gascogne* (3 vols. Paris, 1886).

Gas-engine. Gas-engines are heat-engines of a type in which the fuel is combustible gas, which is burned within the engine itself. In all heat-engines there is a working substance, which is alternately heated and cooled, and does work by alternate expansion and contraction of its volume, thereby converting into mechanical form a portion of the energy which is communicated to it as heat. In most heat-engines the combustion of the fuel which supplies heat to the working substance goes on outside of the vessels within which the working substance is contained: the steam-engine is a characteristic example of this class. Gas-engines, on the other hand, belong to the internal combustion class: *the working substance is made up of the fuel* itself—before and after combustion—along with a certain quantity of diluting air. Internal combustion engines have the enormous advantage that there is no heating surface of metal through which the heat must pass on its way to the working substance. The existence of a heating surface in the external combustion engine imposes practically a somewhat low limit upon the highest temperature to which the working substance may be raised. In gas-engines a far higher temperature is practicable, and the result is that it becomes possible to convert a larger fraction of the heat into work. The theory of Thermodynamics (q.v.) shows that even the most efficient conceivable heat-engine can convert into work no more than a certain fraction of the heat supplied to it—a fraction which is increased by increasing the range through which the temperature of the working substance is caused to vary. This range is much greater in the gas-engine than in the steam-engine, and the ideal efficiency—that is to say, the fraction of the heat convertible into work—is consequently greater. In practice, although the gas-engine as yet falls short of its ideal efficiency to a much greater extent than does the steam-engine, it is actually the more efficient of the two. A pound of fuel converted into gas and used in a modern gas-engine gives a better return in mechanical work than if it were burned in the furnace of a steam-engine of the most economical type. For small powers the gas-engine has the great practical merit, as compared with the steam-engine, of dispensing with the attendance which a boiler and furnace would require. This consideration has made it in many thousands of cases an economical motor even when the gas it uses is of the comparatively costly kind supplied for illuminating purposes.

From the year 1823 onwards a number of proposals were made by Brown, Wright, Barnett, and others for the construction of engines to work by the explosive combustion of gas. Although in some instances these inventions anticipated later successful engines, and although the details were often carefully elaborated, no practical success was attained till 1860, when an effective gas-engine was brought into public use by M. Lenoir.

Lenoir's engine resembled in appearance a single-cylinder horizontal steam-engine. As the piston advanced it drew in an explosive mixture of gas and air. About mid-stroke this was ignited by an electric spark, and for the remainder of the stroke work was done through the pressure of the hot products of the explosion. During the back-stroke these products were expelled to the atmosphere, while on the other side of the piston a fresh explosive mixture was being taken in and exploded at mid-stroke as before. To keep the cylinder cool enough to admit of lubrication it was surrounded by an external casing within which cold water was caused to circulate. This water-jacket has continued to be a feature of nearly all modern gas-engines. An indicator-diagram from Lenoir's engine is shown in fig. 1. From A to B the gas and air are

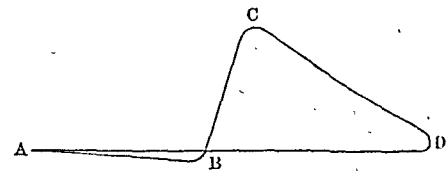


Fig. 1.—Indicator-diagram of Lenoir's Engine.

being sucked in. The rapid rise of pressure from B to C is due to the ignition of the mixture. After C the hot products of combustion go on expanding to *the end of the stroke, D, and the pressure diminishes* although (as recent investigations have shown) the process of combustion is to some extent continued into this stage. The back-stroke, DA, expels the burned gases at atmospheric pressure.

Lenoir's engine used about 95 cubic feet of gas per horse-power per hour, which is about five times the quantity required by the best gas-engines of the present day. Its poor economy was mainly due to the small amount of expansion which the hot gases underwent after the explosion. Another drawback was that the average pressure upon the piston was so low as to make the engine bulky in proportion to the work performed by it. These defects are remedied in modern gas-engines by compressing the mixture before it is exploded, so that a greater range of expansion is required to reduce the burned gases to the atmospheric pressure at which they are expelled. This secures greater efficiency, while at the same time the higher mean effective pressure of the working substance permits an engine of a given size to have more power. Compression of the explosive mixture had been proposed by Barnett as early as 1838, and was a feature in several later patents; but its advantages were first practically realised in the well-known and highly successful engine of Otto, which dates from 1876.

Nine years earlier (in 1867) a gas-engine had been commercially introduced by Otto in conjunction with Langen which, although now obsolete, deserves mention both on account of the success which it achieved and the peculiarity of its action. The Otto and Langen engine was of the free-piston type (originally proposed by Barranti and Matteucci in 1857). There was no compression of the explosive mixture; it was taken in during the early part of the up-stroke of a piston which rose in a vertical cylinder. Then the mixture was ignited by being brought into momentary contact with a

flame through the action of a special slide-valve. Under the impulse of the explosion the piston rose with great velocity to the top of its stroke, being free to rise without doing work on the engine shaft. The burned gases then cooled, and their pressure fell below that of the atmosphere. The piston was therefore urged down by the pressure of the air, and in coming down it was automatically put into gear with the shaft, and so did work, the products of combustion being expelled during the last part of the down-stroke. The engine was excessively noisy, but it took less than half the amount of gas that had been taken by Lenoir.

Otto's invention of 1876 again halved the consumption of gas, and quickly raised the gas-engine to the position of a commercially important motor. Its success may be judged from the fact that in 1889 there were some thirty thousand engines of this type in use, of sizes which give from 100 horse-power down to a fraction of 1 horse-power. In the Otto engine the cylinder is generally horizontal and single-acting, with a trunk piston, and it takes two revolutions of the crank-shaft to complete a cycle of operations. During the first forward stroke gas and air are drawn in, in the proportion proper to form an explosive mixture. During the first backward stroke the mixture is compressed into a large clearance space behind the piston. When the next forward stroke is about to begin, the compressed mixture is ignited, and work is done by the heated gases during the second forward stroke. The second backward stroke completes the cycle by causing the burned gases to be expelled into an exhaust-pipe leading to the outer air. The clearance space is, however, left full of burned gases, and this portion of the previous charge is allowed to mix with the fresh air and gas which is drawn in during the first forward stroke of the next cycle. Since only one of the four strokes which are required to complete a cycle is effective in doing work, a massive fly-wheel, running fast, is used to furnish a large magazine of energy, and in cases where exceptional uniformity of speed is important—as, for instance, in electric lighting—it is usual to have two heavy fly-wheels. A centrifugal governor controls the engine by cutting off the supply of gas when the speed exceeds a prescribed limit. The cylinder is kept moderately cool by the circulation of cold water in a water-jacket; and the usual means of igniting the charge is a slide-valve, the construction of which is described below.

The general appearance of an Otto engine, as made by Messrs Crossley Brothers, is too well known to need an extended description. It resembles a single-cylinder horizontal steam-engine, heavily built and mounted on a somewhat high bed-plate.

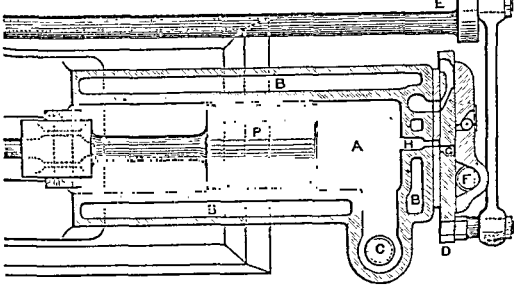


Fig. 2.—Section through Cylinder of Otto's Engine.

In the smallest forms a vertical arrangement of the cylinder is adopted, and for the largest powers a pair of horizontal cylinders are set side by side. Fig. 2 shows some of the principal details by a horizontal section through the cylinder. The piston, P, appears in the figure at the back end of its stroke, and the space A is the clearance. Its volume is usually from two to three fifths of the volume swept through by the piston. BBB is the water-jacket. C is the exhaust-valve, which is opened by the action of a revolving cam during the second back-stroke of the cycle. The slide-valve, D, is made to slide backwards and forwards across the back end of the cylinder by means of a connecting-rod driven by a short crank on the lay-shaft, E, which is driven by bevel or screw gear from the main shaft, so that it turns once for two revolutions of the main shaft. This valve serves to admit gas and air, and also to carry an igniting flame to the mixture after compression in the cylinder. An igniting jet is kept burning at F, behind the valve. In the valve there is a small chamber, G, supplied with gas, and as this passes the jet it ignites and continues burning until by the further movement of the valve the chamber, G, communicates with the cylinder through the opening H, by which time the back of the chamber is closed. In a number of recent Otto engines the ignition of the mixture is brought about in a different way. There is a short tube closed at one end and communicating at the other with the cylinder, through a valve. The tube is kept red-hot by a Bunsen-flame playing round it, and at the proper moment a portion of the charge within the cylinder is allowed access to the red-hot tube through the valve.

Fig. 3 is a copy of an indicator-diagram from an Otto engine. AB is the first stroke of the cycle,

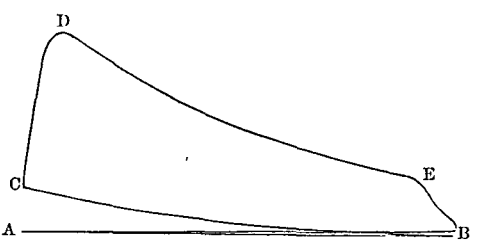


Fig. 3.—Indicator-diagram of Otto's Engine.

and corresponds to the taking in of gas and air at a pressure sensibly the same as that of the atmosphere. BC is the compression stroke. At C ignition takes place and raises the pressure quickly to D. CDEB is the effective forward stroke, and the exhaust-valve is opened for the escape of the waste gases near the end of this stroke at E. The expulsion of the gases goes on from B as the piston moves back to A, and this completes the cycle.

There are now a number of other successful gas-engines which more or less resemble Otto's. In Clerk's engine a similar cycle is performed, except that there is an explosion at each forward stroke. The waste gases escape through exhaust-ports near the front end of the cylinder, which are uncovered by the advance of the piston, and a displacer cylinder or pump immediately forces in a fresh mixture, which is compressed during the return stroke. In Andrew's (the Stockport) engine, and in Robson's (made by Messrs Tangye), an impulse in every revolution is secured by compressing the explosive mixture in a pump, which in some cases is supplied by using the front end of the working cylinder itself for this purpose. In the 'Griffin' engine (Messrs Dick, Kerr, & Co.) explosion occurs at both ends of the cylinder, but only at every third stroke: the cycle includes the drawing in and rejecting of a 'scavenger' charge of air, as well as the drawing in and compression of the explosive mixture and the rejection of the burned gases. A recent engine

possessing much originality is Atkinson's, the distinctive features of which are shown in fig. 4. Here the piston acts on the crank-shaft not directly but through a toggle-joint, which has the effect of compelling the piston to make four single strokes for

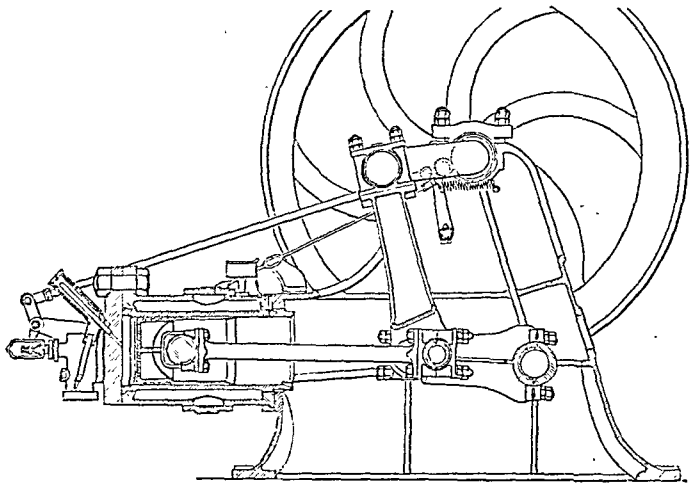


Fig. 4.—Atkinson's Gas-engine.

one revolution of the shaft. The four strokes are of different lengths. In the first forward stroke the piston starts from the back end of the cylinder and draws in gas and air. Returning it makes a shorter stroke, compressing the mixture into a space not swept through. Then the mixture is fired, and work is done during another and considerably longer forward stroke, and finally the cycle is completed by a return stroke, which is long enough to completely expel the burned gases. The mixture is ignited by means of a red-hot tube, but in this case there is no valve to control the time of firing; it is determined simply by the compression of the explosive mixture against a cushion of waste gas in the top of the tube. Fig. 5 is an indicator-diagram from Atkinson's engine. AB is the admission stroke. From B to C the explosive mixture is compressed; at C it is fired, and the effective working stroke, CDE, begins. Its length is more than twice that of

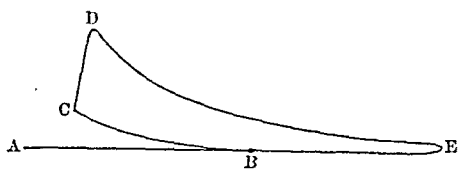


Fig. 5.—Indicator-diagram of Atkinson's Engine.

the compression stroke. In the long return stroke, EA, the products of combustion are wholly expelled, except for a small quantity contained in the clearance space, which is no greater than the clearance necessarily left behind any piston. This complete (or, to be more exact, nearly complete) expulsion of the burned gases is a good feature in Atkinson's cycle, but the most distinctive merit is the relatively long working stroke, which secures much expansion, so that the gases do not escape until their pressure falls to a value not greatly exceeding that of the atmosphere, and at the same time makes the expansion occur quickly, giving the hot gases comparatively little time to part with their heat to the lining of the cylinder.

Messrs Crossley have lately introduced a modified form of Otto engine, with two equal cylinders, the pistons of which make their strokes simultaneously. The mixture is compressed, exploded, and expanded first behind one piston; then the products of combustion are allowed to pass to the front end of both cylinders, driving back both pistons, and undergoing further expansion. Meanwhile the other cylinder has taken in a fresh charge, which is now compressed behind its piston, and is exploded when the next forward stroke begins.

During the explosion in a gas-engine cylinder the highest value of the pressure is usually from 180 to 200 lb. per square inch, and the highest temperature is about 3000° F. The process of explosion is by no means instantaneous. After ignition the pressure and temperature rise with great rapidity, as the indicator-diagrams (figs. 3 and 5) show, but combustion is not complete when the highest point in the diagram has been reached. Only about 60 per cent. of the whole heat which the combustion of the gas should yield is developed up to that point. During the subsequent expansion a slow process of continued combustion goes on, in which a considerable part of the remaining 40 per cent. is set free; but even when the contents of the cylinder escape to the exhaust the process is generally still incomplete. The after-burning, as it is called, which occurs during expansion, after the point of highest pressure has been passed, has the effect of keeping the pressure of the expanding gas from falling so fast as it otherwise would fall. But for this the expansion curve on the indicator-diagram would fall very rapidly, owing to the cooling of the gases through their contact with the cylinder walls. During expansion the gases are parting with much heat to the walls, but the after-burning supplies nearly enough additional heat to make good this loss—sometimes, indeed, more than enough—and the result is that the form of the expansion curve does not differ very materially from that of an adiabatic line. The experiments of Mr Dugald Clerk, who has taken much pains to investigate this action, show that the time-rate of the explosion depends greatly on the richness of the explosive mixture. When the mixture is much diluted the process is so slow that the point of highest pressure is not reached until far on in the stroke.

Though the maximum temperature within the cylinder is materially reduced by this want of perfect suddenness in the combustion of the gas, it is still so high that in engines of even very moderate size a water-jacket is essential. The actual maximum temperature of the gases is in fact higher than the melting-point of cast-iron, while the temperature of the metal has to be kept low enough not to burn oil. The water-jacket involves an immense waste of heat. In the most favourable cases it absorbs 27 per cent. of the whole heat which would be produced by complete combustion of the gaseous mixture, and more generally the amount it absorbs ranges from 40 to 50 per cent. The best existing gas-engines succeed in converting into work about 22 per cent. of the whole potential energy of the fuel; of the remaining 78 per cent. a half or more generally goes to heat the water which circulates in the jacket, and the remainder is rejected in the exhaust, partly through incomplete combustion, but mainly in the form of actual heat, on account of the high temperature at which the waste gases escape. Attempts have been made to save a part of this loss

by the application to gas-engines of the regenerative principle which has done so much to promote economy of heat in metallurgical operations. It was proposed by Siemens to use a separate combustion chamber, which, being distinct from the working cylinder, might be kept always hot, and to pass the outgoing gases through a regenerator, which would take up their heat and give it back to the incoming air. Much the same end was aimed at by Fleeming Jenkin, who tried to adapt the regenerative engine of Stirling (see AIR-ENGINE) to serve for the internal combustion of gas. These attempts have hitherto failed, and the gas-engine still falls far short of the limit of thermodynamic efficiency which its high range of temperature shows it to be theoretically capable of. The greatest ideal efficiency of any heat-engine is measured by the fraction $\frac{\tau_1 - \tau_2}{\tau_1}$, where τ_1 is the highest (absolute) temperature at which it can receive heat, and τ_2 is the lowest (absolute) temperature at which it can reject heat. The highest temperature in the combustion is, as we have seen, about 3000° F., and the lower limit of the range is the atmospheric temperature, or say 60° F. Substituting these values in the formula, we have 0·85 as the highest ideal efficiency; in other words, it should be, from the thermodynamic point of view, theoretically possible to convert 85 per cent. of the heat-energy of the gas into work. The greatest efficiency hitherto realised is about 0·22, or little more than one-fourth of the ideal efficiency. It must not be supposed that under any imaginable practical conditions it could be possible to reach the ideal limit, but it may be confidently expected that the gas-engine of the future will approach it much more closely than does the gas-engine of to-day. The comparison serves to show how much room there is for invention in the direction of obviating what is essentially preventable loss.

It is instructive in this connection to compare the efficiency of gas-engines with that of steam-engines. In a large steam-engine the efficiency is about 0·15; in other words, the engine converts into work only some 15 per cent. of the heat-energy supplied to the steam, and the figure would be greatly less if one stated it as a fraction of the whole heat of combustion of the fuel. In steam-engines small enough to be fairly comparable with actual gas-engines, the efficiency is rarely more, and generally a good deal less, than 0·1. Considered as a thermodynamic machine, the gas-engine, imperfect as it admittedly is, is already not far from twice as efficient as the steam-engine. It is in fact the most efficient heat-engine we possess.

Experiments show that the consumption of gas in practice in a small gas-engine (indicating 10 horse-power or more) may, in favourable cases, be less than 20 cubic feet per hour per indicated horse-power, including the gas which is consumed in maintaining the igniting flame. Of the indicated horse-power about 85 per cent. is available for doing mechanical work outside of the engine itself. The cost of the fuel is necessarily high so long as the gas supplied to the engine is the purified coal-gas used for lighting. Thus, with gas costing 3s. per 1000 cubic feet, the supply required for each indicated horse-power per hour will cost about three-farthings, whereas the coal bill of a steam-engine for each horse-power hour need not exceed a fifth of a penny, and may be even less. In such cases the advantage of the gas-engine lies in its compactness and convenience, in the saving of charges for attendance, and in the ease and economy with which it can be applied to do intermittent work. Economy in the cost of fuel may, however, be secured by supplying the engine with a cheaper kind of gas, a gas suitable for heating though not suitable for illumination. The late Sir William Siemens pointed out that a comparatively cheap gas of the kind required might be got by separating successive stages in the distillation of coal, and urged the desirability of supplying towns with such a gas for heat and power through mains distinct from those already in use. A public supply of water-gas has also been proposed. Another cheap gas which has been very successfully used in gas-engines is the gas produced by Mr Emerson Dowson's process of blowing a mixture of air and steam through a bed of red-hot anthracite or coke. The product contains 22½ per cent. of hydrogen and the same quantity of carbonic oxide, mixed with much nitrogen and a small quantity of carbonic acid, and is said to cost about 2½d. per 1000 cubic feet. The engine requires about four times as much of it as it would require of illuminating coal-gas. When Dowson gas is used, the consumption of fuel in supplying a gas-engine is found to be not more than 1½ lb. of coke or anthracite per horse-power per hour—a result that compares most favourably with the 4 or 5 lb. usually burned in a steam-engine of corresponding size. Even the best large steam-engines do not achieve so great an economy of fuel.

A notice of gas-engines would be incomplete without a reference to *oil-engines*, using petroleum as fuel, which is vaporised and then exploded along with air. In Priestman's engine the petroleum, which is a safe oil with a flashing-point higher than 75° F., is injected in the form of spray, by a jet of compressed air, into a chamber which is heated by means of a jacket through which the hot gases of the exhaust pass. There the spray is raised to a temperature of about 300°, and is completely vaporised. From the hot chamber the vapour is drawn, along with more air, into the working cylinder, where the cycle of operations is essentially the same as in Otto's engine. In the most recent forms of this very promising motor, only 1¼ lb. of oil is burned per brake horse-power per hour.

References.—D. Clerk, *The Gas-engine* (1886); W. MacGregor, *Gas-engines* (1885); Papers by D. Clerk 'On the Theory of the Gas-engine' and 'On the Explosion of Homogeneous Gaseous Mixtures,' *Min. Proc. Inst. C.E.* (1882 and 1886); Ayrton and Perry, *Phil. Mag.* (1884); Brooks and Steward, *Van Nostrand's Engineering Mag.* (1883); Slade, *Jour. Franklin Inst.* (1886); Lecture by F. Jenkin on 'Gas-engines,' *Inst. Civ. Eng.* (1884); Report to the Society of Arts on Trials of Motors for Electric Lighting (1889).

Gaskell, MRS, an eminent English novelist, was born at Cheyne Row, Chelsea, 29th September 1810. Her maiden name was Elizabeth Cleghorn Stevenson, and her father was in succession teacher, preacher, farmer, boarding-house keeper, writer, and Keeper of the Records to the Treasury. She was brought up by an aunt at Knutsford—the Cranford which she was yet to describe with such truthful patience—and grew up a girl of singular sweetness of disposition and of great beauty. She was carefully educated, and married in 1832 William Gaskell (1805–84), a Unitarian minister in Manchester. Here she studied working men and women from the life, and devoted her days and nights to teaching them and relieving their distress. In 1848 she published anonymously her *Mary Barton*, which at once arrested public attention. It was followed by *The Moorland Cottage* (1850), *Cranford* (1853), *Ruth* (1853), *North and South* (1855), *Round the Sofa* (1859), *Right at Last* (1860), *Sylvia's Lovers* (1863), *Cousin Phillis* (1865), and *Wives and Daughters* (1865), a series of novels that have permanently enriched English literature, and almost lifted their authoress into a rank represented alone by Jane Austen, Charlotte Brontë, and

George Eliot. Mrs Gaskell had some measure of almost all the gifts of the great novelist—deep and genuine pathos, a singularly genial and truthful humour, a graceful and unforced style, power of description, dramatic faculty on occasion, and sympathetic insight into character; while she wrote of nothing that she did not know and understand—indeed many passages are close transcripts from her own life-history and experience. Though written with a purpose, her novels have not failed to be completely artistic, perhaps because they flowed so freely from her heart, and because their purpose was so truly and so much herself. Mrs Gaskell died suddenly of heart-disease at Holybourne, Alton, in Hampshire, 12th November 1865, and was fittingly buried at Knutsford. Besides her novels she wrote *The Life of Charlotte Brontë* (1857), which will remain one of the masterpieces of English biography. *Mary Barton* was received as a revelation of the habits, thoughts, privations, and struggles of the industrial poor, as these are to be found in such a social beehive as Manchester, and has had in its kind many imitators, but not an equal.

Gasometer. See GAS.

Gasparin, VALÉRIE BOISSIER, COMTESSE DE, was born at Geneva in 1813, and married Count Agénor de Gasparin (1810–71), a zealous advocate of religious liberty. She herself became distinguished among the defenders of the Reformed Communion; withal, she has exposed what she deems the religious and social extravagance of certain sects. Two of her works obtained the Montyon prize at the Académie Française: *Le Mariage au point de vue Chrétien*, and *Il y a des Pauvres à Paris et ailleurs.* Among her other publications are *Voyage dans le Midi par une ignorante, Allons faire Fortune à Paris, Un Livre pour les Femmes Mariées, Lisez et Jugez* (Strictures on the 'Salvation Army'), and *Les Horizons Prochaines.* Several of her books have been translated into English.

Gaspé, a peninsula in the east of Quebec province, comprising the counties of Gaspé and Bonaventure, projects into the Gulf of St Lawrence, between the estuary of that name on the north and the Bay of Chaleurs on the south. It has an area of nearly 8000 sq. m., and about 35,000 inhabitants, the greater number engaged in the important fisheries, which, with the export of lumber, form the staple business of the country.—GASPÉ BASIN, where Cartier landed in 1534 (see CANADA), is a port of entry in Gaspé Bay, now the seat of extensive fisheries. Pop. 726.

Gassendi, or GASSEND, PIERRE, French philosopher and mathematician, was born 22d January 1592, at Champtercier, a village of Provence. His unusual powers of mind showed themselves at an early age. Having resolved upon an ecclesiastical career, he studied, and afterwards taught, philosophy at Aix. But, catching the infection of empirical methods of study, he revolted from the predominant scholastic philosophy, and began to subject it to a critical scrutiny. At the same time he bent his energies upon physics and astronomy. The results of his examination of the Aristotelian system and methods appeared at Grenoble in 1624, *Exercitationes paradoxicæ adversus Aristotelcos*, in which he utters an emphatic protest against accepting the Aristotelian dicta as final in all matters of philosophy, and especially of physics. In the same year he was appointed *prévôt* of the cathedral at Digne, an office which enabled him to pursue without distraction his researches in astronomy and other natural sciences. From 1628 he spent several years travelling through Holland, Flanders, and France, until in 1645 he was appointed professor of Mathematics in the Collége Royal de France, at Paris, where he died, 14th October 1655. During his stay in the Low Countries he controverted (1631) the mystical opinions of Robert Fludd, and wrote a treatise on parhelia, besides other astronomical papers. Eleven years later he proceeded also to criticise adversely the new system of philosophy promulgated by Descartes, in a work entitled *Objectiones ad Meditationes Cartesii.* Whilst at Paris Gassendi wrote his principal philosophical works, *De Vita Epicuri* (1647); a commentary on Diogenes Laertius' tenth book, *De Vita, Moribus, et Placitis Epicuri* (1649); and in the same year the *Syntagma Philosophiæ Epicureæ*, which contains a complete view of the system of Epicurus. But, whilst thus going back to the ancients in his philosophy, Gassendi marched in the van of the moderns in natural and physical science. Kepler and Galileo were numbered amongst his friends. His *Institutio Astronomica* (1647) is a clear and connected representation of the state of the science in his own day; in his *Tychonis Brahæi, Nicolai Copernici, Georgii Purbachii, et Joannis Regiomontani Vitæ* (Paris, 1654) he gives not only a masterly account of the lives of these men, but likewise a complete history of astronomy down to his own time. His collected works were published by Montmort and Sorbière (6 vols. Lyons, 1658), and by Averrani (6 vols. Flor. 1728).

Gassner, JOHANN JOSEPH, exorcist, was born 28th August 1727, near Pludenz, in the Vorarlberg, and became Catholic priest at Klösterle, in the diocese of Coire. He began to cure the sick by driving out the demons that possessed them by means of exorcism and prayer. In 1774 he received the sanction of the Bishop of Ratisbon; and by the mere word of command, *Cesset* ('Give over'), he cured the lame or blind, but especially those afflicted with convulsions and epilepsy, who were all supposed to be possessed by the devil. Ultimately he was found to be an impostor; the archbishops of Prague and Salzburg issued pastorals against his imposture, and the imperial authorities compelled the Bishop of Ratisbon to dismiss him. But he died, March 1779, in possession of the wealthy deanery of Benndorf.

Gas-tar. See COAL-TAR, GAS, ANILINE, DYEING, &c.

Gastein, a romantic valley in the south of the Austrian duchy of Salzburg, 28 miles long, with a number of small villages. The chief of these, Wildbad-Gastein, is a very famous watering-place, and was a favourite resort of the Emperor William I. of Germany. Some 5000 guests visit the place in summer to drink the waters of its seven warm springs. Here, on 14th August 1865, a convention was signed between Austria and Prussia, which, by a partition of Sleswick and Holstein, for a short period prevented the rupture between the rival powers. Pop. of the valley, about 4000. See W. Fraser Rae's *Austrian Health Resorts* (1888).

Gasteropoda (Gr., 'belly-footed'), a large class of molluscs, including snails, slugs, buckies, whelks, cowries, limpets, and the like. Along with the cuttle-fishes or Cephalopods, and the yet more closely allied 'butterfly-snails' or Pteropods, the Gasteropods are contrasted with the bivalves or Lamellibranchs by the more or less prominent development of the head-region, and by the presence of a rasping ribbon or tongue on the floor of the mouth.

General Characters.—In addition to the development of head and rasping tongue, the Gasteropods are characterised by the nature of the 'foot' or muscular ventral surface. Except in some forms adapted for free-swimming, the 'foot' is simple,

median, and sole-like. It is the surface on which the animal crawls, and is often divided into anterior, median, and posterior regions. The wealth of modification included in the class is so great that no other general characters can be given.

General Survey.—(A) The simplest Gasteropods, such as the common Chiton, are symmetrical, not

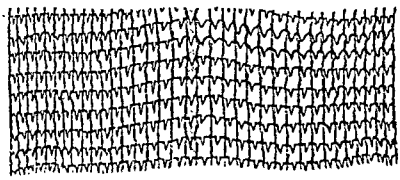


Fig. 1.—Part of the Rasper of the Snail (from Howes).

lop-sided like the higher forms. They have the mouth at one end of the long axis of the body, the anus at the other; the gills, kidneys, genital ducts, and circulatory organs are paired; there are two pairs (pedal and visceral) of nerve cords running parallel to one another along the body, and the ganglia are slightly developed. Of all molluscs these simplest Gasteropods are probably nearest the hypothetical worm-like ancestor. In one order (Chitons, q.v.) there are eight shells, one behind the other like segments; in the two other orders (Neomeniæ and Chætoderma) the shell is represented only by calcareous plates and spines in the skin. These three orders form the sub-class Isopleura, in contrast to all the others which are unsymmetrical—the Anisopleura.

(B) The latter are grouped first of all according to the state of the loop formed by the visceral nerves. (1) In one series the visceral nerve-loop is implicated and twisted in the torsion of the asymmetrical body, and furthermore the sexes are separate. These are known as Streptoneura ('loop-nerved'), and include limpets (Patella), ear-shells (Haliotis), pond-snail (Paludina), cowries (Cypræa), cone-shells (Conus), buckies (Buccinum), and the free-swimming Heteropods.

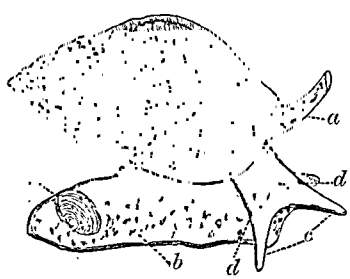


Fig. 2.—A Whelk:
Showing respiratory siphon, *a*; head with tenacles, *c*, and eyes, *d*; foot, *b*, with shell-lid or operculum, *e*.

This division includes what are often called Prosobranchs, and the numerous genera are further arranged according to the characters of the gills, kidneys, and foot. (2) In another series the visceral loop is not twisted, and is often very short; the shell is light and often lost in the adult; and the animals are hermaphrodite. They are known as Euthyneura ('straight-nerved'), and include two sets—Opisthobranchs and Pulmonates. Among Opisthobranchs some retain the usual mantle-fold and have a delicate shell—e.g. Bulla and Aplysia, while others (known as Nudibranchs) have their mantle atrophied and no shell—e.g. Doris and Eolis. Lastly there are the Pulmonates, where gills are replaced by an air-breathing mantle-cavity, as in snails (e.g. Helix), slugs (e.g. Arion), water-snails (e.g. Lymnæus).

Mode of Life.—Though the number of terrestrial Gasteropods, breathing the air directly by means of a pulmonary chamber, is very large—over 6000 living species—those living in water are greatly in the majority, including over 10,000 forms, mostly marine. Of these, some 9000 or so belong to the Prosobranchs or Streptoneura, a relatively small minority being Opisthobranchs and Nudibranchs. The Heteropods and some Opisthobranchs enjoy a free-swimming pelagic life, but most marine forms frequent the coasts either on the shores or along the bottom. Deep-sea Gasteropods are comparatively few. The locomotion effected by the contractions of the muscular 'foot' is in almost all cases very leisurely, and the average tendency is towards sluggishness. As to diet, the greatest variety obtains; most Prosobranchs with a respiratory siphon and a corresponding notch in the shell are carnivorous, and so are the active Heteropods; most of the rest are vegetarian in diet. Numerous genera, both marine and terrestrial, are very indiscriminate in their feeding; others are as markedly specialists, keeping almost exclusively to some one vegetable or animal diet. Some marine snails partial to Echinoderms have got over the digestive difficulty presented by the calcareous character of the skins of their victims by a secretion of free sulphuric acid from the mouth. This acid changes the carbonate of lime into sulphate, which is brittle and readily pulverised by the rasping tongue. A few are parasitic—e.g. Eulima, Stylifer, and the very degenerate *Entoconcha mirabilis*, all occurring in or on Holothurians.

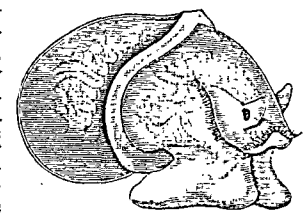


Fig. 3.
Young Pond Snail (*Lymnæus*) (from Howes).

Distribution.—A few Gasteropods occur in strata as far back as the Cambrian, from which remote period they have continued with a steady increase. Almost all the Palæozoic genera are now extinct, and during these ages the siphon-possessing forms seem to have been almost, if not altogether, unrepresented. A host of new Gasteropods appeared in the Jurassic period, and many of the modern families have their origin in Cretaceous times. Numerous as the fossil forms are, the number of types wholly extinct is comparatively small; both as regards persistence of types and increase of numbers, the Gasteropods are a peculiarly successful class.

Life-history.—The eggs of Gasteropods are usually small, and are surrounded with albumen, the surface of which becomes firm, while in the common snail (Helix) and some others there is an egg-shell of lime. The eggs not unfrequently develop into embryos within the parent, but in most cases they are laid, either singly or in masses, and often within cocoons. Few objects are more familiar on the seashore than the clustered egg-cases of the whelk, which together form a ball often about the size of an orange. Inside each of the numerous egg-cases are many embryos, but only a few reach maturity, the others serving as food material, an infantile cannibalism or struggle for existence not uncommon in the class. As to the actual development and the larval forms, reference must be made

Fig. 4.
Section of Triton-shell (after Owen):
ac, notch for siphon; *c*, axis or columella.

to the articles on MOLLUSCS and on EMBRYOLOGY; but it may be noted that the ovum divides more or less unequally, according to the amount of yolk, that a gastrula-stage occurs as usual, and that this is succeeded in typical cases, first by a 'Trochosphere' and afterwards by a 'Veliger' larva (see MOLLUSCS).

General Interest.—As voracious animals, furnished with powerful rasping organs, many Gasteropods play an important part in the struggle for existence among marine organisms, while other terrestrial forms are most destructive devastators of vegetable and flowering plants. The manner in which numerous plants are saved from the ravages of snails, by their chemical and physical characters, is an interesting subject of investigation recently worked out by Professor E. Stahl. From very early times, various Gasteropods, such as whelks, have been utilised for human consumption and also as bait, while yet more frequently the shells, often so beautiful in form and colour, have been used for the decoration of the person and the dwelling, for the basis of cameos, as domestic utensils, or even as weapons, and in many other ways. From the mucous glands of the roof of the gill-cavity in the genera Purpura and Murex, there exudes the famous secretion, at first colourless, but afterwards becoming purple or violet, which furnished the ancient Tyrian dye.

See CHITON, LIMPET, MOLLUSC, NUDIBRANCH, SNAIL, WHELK, and articles dealing with various Gasteropods above mentioned. Also the zoological text-books of Claus, Gegenbaur, Huxley, &c.; Hatchett Jackson's ed. of Rolleston's *Forms of Animal Life* (Oxford, 1888); Keferstein's 'Mollusca,' in Bronn's *Thierreich* (1862-66); E. Ray Lankester, article 'Mollusca,' *Ency. Brit.* (vol. xvi. 1883); Woodward, *Manual of Mollusca* (3d ed. 1875).

Gaston de Foix. See FOIX.

Gastræa, Gastrula. See EMBRYOLOGY.

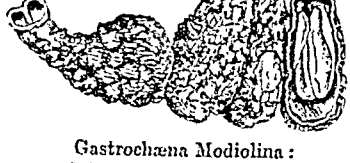
Gastralgia. See CARDIALGIA.

Gastric Fever. See TYPHOID FEVER.

Gastric Juice. See DIGESTION.

Gastritis. See STOMACH (DISEASES OF).

Gastrochæ'na, a genus of boring bivalves, not far removed from Teredo and Pholas, but type of a distinct family, Gastrochænidæ, which also includes the remarkable Aspergillum (q.v.) and Clavagella (q.v.). The original shell has the two valves typical of Lamellibranchs; but these are delicate, and become surrounded by a secondary tubular shell lining the cavity which the mollusc bores in limestone, coral, other shells, &c. *G. modiolina*, a rare British mollusc, common in the Mediterranean, makes holes about two inches deep and half an inch in diameter. It sometimes bores right through an oyster into the ground below, and makes for itself, plus little stones and particles of debris, a flask-shaped case, with its neck fixed in the oyster-shell. The tubes of some of the tropical species—e.g. *G. clava*, from the Indian Ocean, which live in sand are very curious.



Gastrochæna Modiolina: *a*, one of the tubes broken open, showing the valves.

Gastro'stomy (Gr. *gastēr*, 'the belly or stomach;' and *stoma*, 'mouth'), an operation performed for the relief of stricture of the gullet, to save the patient from the imminent risk of starvation by introducing food directly into the stomach *through an external opening*. The well-known case of Alexis St Martin, a Canadian, in whom in consequence of a gunshot wound there was a fistulous opening into the interior of his stomach, the success of operations for the removal of foreign bodies from the stomach, and numerous experiments on the lower animals, led to this attempt to save life; and when it is not delayed too long it has proved successful in a fair proportion of cases.

Gastro'tomy (Gr. *gastēr* and *tomē*, 'an incision'), an incision into the cavity of the Abdomen (q.v.) generally for the purpose of removing some diseased texture or foreign body. The term has also been applied to Cæsarean Operation (q.v.).

Gataker, THOMAS, English divine, was born in London in 1574, and educated at St John's College, Cambridge. In succession preacher at Lincoln's Inn, rector of Rotherhithe, and member of the Assembly of Divines at Westminster, he opposed the imposition of the Covenant, and was one of the forty-seven London clergymen who condemned the trial of Charles I. He died in 1654. His works include *Of the Nature and Use of Lots* (1616); and *Cinnus, sive Adversaria Miscellanea* (1651).

Gatchina, a town of Russia, 30 miles by rail SSW. of St Petersburg. It has some manufactures of porcelain, and several barracks, but is especially worthy of mention for its royal palace, surrounded by one of the finest pleasure-gardens in Europe, which was the favourite summer seat of the Emperor Paul I., and the winter residence—practically, owing to precautions against Nihilists, the prison—of Alexander III. Pop. (1880) 10,063.

Gates, HORATIO, an American general, was born at Maldon, in Essex, England, in 1728. He entered the English army, served in America, where he was major under Braddock, and with difficulty escaped in the defeat in which that officer was slain. On the peace of 1763 he purchased an estate in Virginia, where he resided until the war of independence. In this struggle he sided with his adoptive country, and in 1775 was made adjutant-general, with the rank of brigadier, receiving in 1776 command of the army which had just retreated from Canada. In August 1777 he superseded Schuyler in command of the northern department; and, principally as the result of his predecessor's able manœuvres, he was enabled to defeat and compel the surrender of the British army at Saratoga in October (see BURGOYNE). This success gained him a great reputation, which probably is accountable for his endeavour to supplant Washington in the chief command of the army; but this failing, he retired to his estate until 1780, when he was called to the command of the army of the South, and in the unfortunate defeat near Camden, in South Carolina, lost the laurels he had previously won. He was superseded, and was not acquitted of blame by court-martial until 1782. He then retired to Virginia till 1790, when he emancipated all his slaves, and settled in New York. There he died on April 10, 1806.

Gateshead, a town in England, on the northern verge of the county of Durham, and on the south bank of the river Tyne. Governed for centuries by a chief bailiff appointed by the prince-bishop of the palatinate, aided by popularly elected burgesses, Gateshead was enfranchised first as a parliamentary borough in 1832, and secondly as a municipal borough in 1835, whilst in 1888 it became a county borough. Its population has grown from 15,177 in 1831 to 25,568 in 1851, 65,855 in 1881, and 74,789 in 1889. Thus there is only one urban community along the main line between

London and Edinburgh which exceeds Gateshead in population; and the exception is the city of Newcastle-upon-Tyne, which is situated directly opposite Gateshead on the Northumberland or northern bank of the river. The two towns are intimately connected: a splendid suspension bridge (1871) joins them at Redheugh; Stephenson's celebrated High Level (1849) connects them by both road and rail; and a swing-bridge (1876), which opens to allow the passage of ships, connects the quayside of Newcastle with the principal thoroughfare of Gateshead. This close association of the two communities is not felt to be of advantage to the Durham borough, because the city on the Northumberland side of the Tyne levies under ancient charter local dues on all the river trade, which both towns promote, though the emoluments derived therefrom belong exclusively to Newcastle. The older portions of Gateshead have not during recent years been much improved. Many of the old stone buildings have been allowed to fall into considerable decay. Westward and southward extension and improvement are continuous, and the suburbs show many fine villas. The town community is for the greater part industrial. Engine-works, iron-shipyards, electric cable, hempen and wire rope manufactories, chemical works, cement-works, glass-works, and iron-works furnish employment to a large proportion of the inhabitants. The only philanthropic institutions in the town which do not owe their existence to modern public spirit are the grammar-school (1700) and the King James Hospital (1611) for poor brethren.

Numerous institutions depend for their support on voluntary contributions and on grants from local rates. These include successful boys' and girls' high schools, excellent swimming-baths, a useful dispensary, a hospital for the isolated treatment of infectious disease, a literary and scientific institute, a school of art, &c. Public libraries (circulating and reference) were inaugurated in 1886, which are free to all burgesses. Under the management of an energetic school-board formed in 1872, two higher-grade and thirty-six elementary schools were opened, in which 20,683 children were in July 1889 receiving instruction. The town-hall and free library are among the architectural ornaments of the borough. A public park at Saltwell, opened in 1874, is also the property of the ratepayers. Besides other places of worship belonging to the various denominations, there are ten churches of the English establishment, including the venerable St Mary's, which in 1080 was the scene of the murder of Bishop Walcher by an English mob. Among places of interest in Gateshead are the site of the fire and explosion of 1854, which cost fifty lives, and destroyed a million pounds' worth of property; the extensive locomotive works of the North-Eastern Railway Company, the finest in the north of England; alleged traces of the ancient Roman headway or *gate's* head, from which the name of the town is said to be derived; the undoubted residence in the Hillgate district, during the writing of the immortal *Robinson Crusoe*, of Daniel Defoe; and the works at which large portions of the first Atlantic cable were manufactured. The quarries from which the world-famous Newcastle grindstones are obtained are also worked within the precincts of Gateshead, at Gateshead Fell. Gateshead continues to be represented, as in 1832, by one member in the House of Commons. For parliamentary and municipal purposes alike, the county borough is divided into ten wards. Its governing body consists of a mayor, ten aldermen, and thirty councillors. See Richard Welford's *History of Newcastle and Gateshead* (2 vols. 1884–85).

Gateway, the passage or opening in which a gate or large door is hung. This may be either an open way with side pillars or a covered way vaulted or roofed over. The gateway, being a most important point in all fortified places, is usually protected by various devices. It is flanked by towers with loopholes, from which assailants may be attacked, and is frequently overhung by a machicolated battlement, from which missiles of every description may be poured upon the besiegers. In the middle ages gateways were also fortified with one portcullis or more, and had frequently an outer work or barbican in front of the gate defended with drawbridges. City gates, and gates of large castles, have in all ages been the subjects of great care in construction; and when from some cause, such as the cessation of constant fighting, or a change in the mode of warfare, gateways have lost their importance in a military point of view they have maintained their position as important architectural works, and although no longer fortified have become ornamental. In very ancient times we read of the 'gate' as the most prominent part of a city, where proclamations were made, and where the kings administered justice. The Greek and Roman gates were frequently of great magnificence. The propylæa at Athens is a beautiful example, and the triumphal arches of the Romans are the ornamental offspring of their city gates. At Autun in France two Roman gateways, and at Trèves in Germany one, still exist, and formed the models on which early medieval gateways were designed. Most of the English towns have lost their walls and city gates; but a few, such as York and Chester, still retain them, and give us an idea of the buildings which formerly existed, but which now remain only in the name of the streets where they once stood. English castles retain more of their ancient gateways, and from these we may imagine the frowning aspect every town presented during the middle ages. Abbeys, colleges, and every class of buildings were shut in and defended by similar barriers; many of these still exist in Oxford and Cambridge, and the abbey gates of Canterbury and Bury St Edmunds are well-known specimens of monastic gateways. The feeling of personal freedom, which is so strong in England, must no doubt have tended greatly to hasten the demolition of these marks of feudalism; but in many parts of the Continent we still find these barriers kept up.

Gath, one of the five chief cities of the Philistines, was situated on the frontiers of Judah, and was in consequence a place of much importance in the wars between the Philistines and the Israelites. The famous giant, Goliath, who was slain by the youthful David, was a native. St Jerome describes it in his time as 'a very large village.' Its site is probably the Blanche Guarde of the Crusaders, who built a castle here to command the Philistine plain.

Gatineau, a river of Quebec, in Canada, has its origin in a chain of lakes lying immediately north of 48° N. lat., and, after a SSW. course estimated at 400 miles, enters the Ottawa River, about a mile below Ottawa city.

Gatling, Richard Jordan, born in 1818, in Hertford county, North Carolina, studied medicine but never practised, and is known for inventions as various as machines for sowing cotton and rice and for dressing hemp, a steam-plough, and the famous Gatling gun (1861–62), a revolving battery gun, usually having ten parallel barrels, and firing in some cases as many as 1200 shots a minute. See Machine Guns.

Gatschina. See Gatchina.

Gatty, MARGARET. See EWING.

Gau, a German word meaning, in a general way, district, but applied specially to a political division of ancient Germany, having relation to the arrangements for war and the administration of justice. The division into such districts was in force under the Franks in the 7th century; and at the head of the gau was the graf (see COUNT). As the grafdoms became more and more hereditary, the gau, as a political division, fell into disuse (about the 12th century), and only in the names of some places—Rheingau, Breisgau, Aargau, &c. —do the traces of it remain. See HUNDRED, FEUDALISM, VILLAGE COMMUNITY.

Gauchos are the herdsmen of the great plains of the Argentine Republic and Uruguay, where they live in rude huts with scanty furniture, and are chiefly employed in driving, catching, and slaughtering cattle. They are mostly of mixed Spanish and Indian descent, sparely built, and of great strength and endurance; they are most expert horsemen, and use the Lasso (q.v.) and Bolas (q.v.) with marvellous skill. Their dress consists of a rough jacket and trousers, over which a woollen *poncho* falls, heavy top-boots, and a wide-brimmed hat. Cheerful and hospitable, they are violent and vindictive when enraged, and are much given to drink and gambling. Inured to hardship and fatigue, they have played an important part in the revolutions of South America.

Gaudeamus, the beginning of a famous German students' song in dog-Latin rhymes, of which the first line is *Gaudeamus igitur juvenes dum sumus* ('Let us therefore rejoice while we are young'). It was first printed, in a somewhat coarser form than the present, and with Latin and German verses alternating, in 1776; and follows rather closely the thought and expression of an ancient Latin hymn of the year 1267. See Schwetschke, *Zur Geschichte des Gaudeamus* (Halle, 1877).

Gauden, JOHN. See EIKON BASILIKE.

Gauge, or GAGE, an apparatus for measuring any special force or dimension; thus we have *pressure-gauge, wind-gauge* (see ANEMOMETER), *Rain-gauge* (q.v.), *wire-gauge, button-gauge,* &c. The simplest form of gauge of dimension is the common wire-gauge, by which the diameter of wire is measured. It is simply an oblong plate of steel, with notches of different widths cut upon the edge; these are numbered, and the size of the wire is determined by trying it in the different notches until the one is found which it exactly fits. The thickness of sheet-metal is tried by the same gauge. There is a great want of uniformity in these gauges—the Birmingham gauge for iron-wire, sheet-iron, and steel differing from that used for brass, silver, gold, &c.; and these again from the Lancashire gauges. It has been proposed, in order to obtain uniformity, and to enable definite descriptions and orders to be given with accuracy and certainty, that, instead of the arbitrary numbers of varying signification now in use, decimal parts of an inch, tenths, hundredths, thousandths, or still smaller fractions, if necessary, be used, and that these be used for all diameters and thicknesses, such as wires, sheet-metals, buttons, watch-glasses, &c.; but such a scale has not yet come into general use. The Birmingham wire-gauge has, however, been widely adopted. The gauge commonly used for buttons and such like larger diameters is a rule with a groove cut lengthwise down the middle. Another metal rule, with a brass head, slides in this, and by means of a thumb-pin may be pushed out at pleasure. The object to be measured is placed between *a* and *b* (fig. 1), and the width of this space is measured by graduations on the middle metal slide.

A very elegant and delicate gauge is used for measuring watch-glasses, and is applicable to many other purposes. On an oblong piece of sheet-metal two straight metal ridges are fixed in such a manner that they shall be inclined at a given angle to each other, as *ab* and *cd* (fig. 2). Now, let us suppose the angle to be such that the distance between *a* and *c* is 2 inches, and that between *b and d is 1 inch*, while the lengths *ab* and *cd* are 10 inches. It is evident that for every inch of descent from *a* and *c* towards *b* and *d* there will be a narrowing equal to $\frac{1}{10}$th of an inch; and for every tenth of an inch of such descent there will be a narrowing of $\frac{1}{100}$th of an inch, and so on: thus we may, by graduating downwards from *ac* to *bd*, measure tenths by units, hundredths by tenths, and so on to still finer quantities if required. This is applicable to lengths as well as diameters. By means of fine screws with large graduated heads, Messrs Whitworth have measured small pieces of steel to the one-millionth of an inch (see MICROMETER). Pressure-gauges, wind-gauges, &c. will be treated under the special subjects.—In railways, the gauge means the distance between the rails (see RAILWAY).—The term GAUGING refers specially to the gauging of the contents of casks; and in many places the popular name for the excise officer who measures the contents of casks containing excisable liquors is 'gauger.'

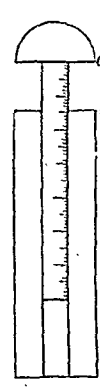


Fig. 1.

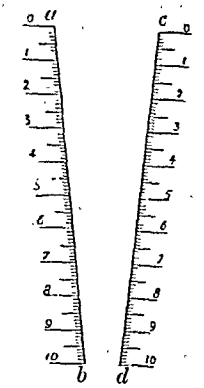


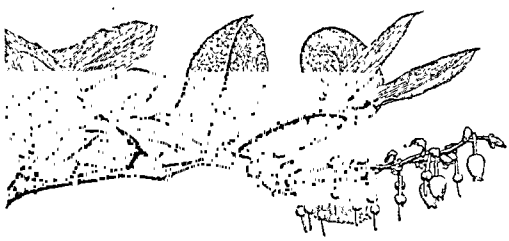
Fig. 2.

Gaul. See FRANCE.

Gault (a local name in Cambridgeshire for clay) is one of the subdivisions of the Cretaceous System (q.v.). The gault is a stiff, bluish-gray clay, which here and there contains indurated nodules and septaria. Now and again it becomes somewhat calcareous, or sandy and micaceous. In some parts of Sussex a band of phosphatic nodules occurs at its base. The deposit is of variable thickness —reaching in some places over 300 feet, while occasionally it hardly attains a greater thickness than 50 feet, and forms a well-marked geological horizon—forming the bottom member of the Upper Cretaceous rocks. It is abundantly fossiliferous, the remains being almost exclusively marine, only a few drifted land-plants having been met with. One of the best exposures of the gault in England is at Folkestone. In the Isle of Wight this formation is known as the 'blue slipper,' from the readiness of the overlying beds to slip or slide over its surface. The picturesque 'Undercliff' owes its origin to these landslides. The gault is extensively employed in the manufacture of bricks and tiles; it forms a retentive and rather unproductive soil.

Gaultheria, a genus of small procumbent evergreen shrubs, of the order Ericaceæ, named by the Swedish botanist Kalm in honour of Dr Gaultier of Quebec. *G. procumbens* is a common plant in North America as far south as Virginia, and bears the names of Checkerberry, Partridge Berry, Deer Berry, Wintergreen, and Mountain Tea. It is about 4 or 5 inches in height, with

small whitish flowers and red 'berries,' which are eatable, but not safe in any considerable quantity, because of the pungent volatile oil which they contain. Brandy in which they have been steeped is used as a tonic. The whole plant has an agreeable aromatic odour and taste, and the volatile oil is used in medicine as a stimulant, also for flavouring syrups, and in perfumery, under the name of *Oil of Wintergreen*. An infusion of the berries (hence called 'tea-berries') was used as tea during the war of independence. The berries are employed for flavouring beer and other drinks, as also for tooth-powders and hair-washes. The leaf is astringent, and is used in medicine.—The Shallon



Shallon (*Gaultheria shallon*).

(*G. shallon*) is a large species (2–3 feet), with purple berries ('salal-berries'), which are largely eaten by the Indians of north-west America. It grows well in woods, and is sometimes planted in Britain to afford food for game.—*G. hispida* (Wax-cluster) is a native of Van Diemen's Land, bearing snow-white berries.—Other species, some fragrant, some producing edible berries, and all beautiful little shrubs, are found in mountain regions throughout the world. The Australian *G. antipoda* is said to be a finer fruit than *G. hispida*.

Gaunt. See GHENT; and for John of Gaunt, see JOHN OF GAUNT.

Gauntlet, less correctly GANTLET (formed with double diminutives from Old Fr. *gant*, 'a glove,' itself a word of Scandinavian origin), an iron glove, which formed part of the armour of knights and men-at-arms. The back of the hand was covered with plates jointed together, so as to permit the hand to close. Gauntlets were introduced about the 13th century. They were often thrown down by way of challenge, like gloves. They are of frequent occurrence in heraldry.

In the phrase 'to run the gantlet,' the word is due to a confusion with the foregoing of the original word *gantlope* or *gatlope*, the Swedish *gatlopp*, made up of *gata*, 'a street,' and *lopp*, 'a course,' from *löpa*, 'to run'—a cognate of Eng. *leap*. Professor Skeat suggests that the word may be due to the wars of Gustavus Adolphus, who died at Lützen in 1632. The German form is *gassenlaufen*, 'lane-run,' both alike meaning a military punishment, which consists in making the culprit, naked to the waist, pass repeatedly through a lane formed of two rows of soldiers, each of whom gives him a stroke as he passes with a short stick or other similar weapon.

Gaur, the medieval capital of Bengal, also called Lakhnauti, is said to have been founded by the Vaidya king Lakshmanasena, at the close of the 11th century, and, on the Mohammedan conquest, a hundred years later, became the chief seat of the viceroys who governed Bengal under the Pathan kings of Delhi, and afterwards (but not always) of the independent kings of Bengal. On the Mogul conquest in 1575 a terrible pestilence broke out at Gaur, and thousands of the inhabitants perished; and from that time the city disappears from history, and its place is taken successively by Tandan, Dacca, and Murshidabad. The ruins of Gaur still cover a space of seven miles by two, on a branch of the Ganges, and include Hindu buildings as well as several interesting 15th-century Mohammedan mosques, besides extensive reservoirs, channels, and embanked roads. The vast accumulations of brick testify to the former density of the population, while the neighbouring ruins of Panduah and Tandan point to the existence of important suburbs, many of which have wholly disappeared. See Ravenshaw, *Gaur, its Ruins and Inscriptions* (1878); Fergusson, *History of Indian Architecture*; Lane-Poole, *Catalogue of Indian Coins in the British Museum*.

Gaur, or GOUR (*Bos Gaurus*), a species of ox, inhabiting some of the mountain jungles of India. It is of very large size, although apparently inferior to the Arnee (q.v.). It bears a considerable resemblance to the Gayal (q.v.), but differs from it in the form of its head, and in the total want of a dewlap, in which it more nearly agrees with the Banteng of the Eastern Archipelago, although distinguished from it by important anatomical peculiarities (see BANTENG). It is supposed to be incapable of domestication; frequent attempts for this purpose are said to have been made in Nepal. From its ferocity its pursuit is reckoned in India as exciting as that of tiger or elephant.

Gauss, JOHANN KARL FRIEDRICH, German mathematician, born at Brunswick, 30th April 1777, in 1801 published an important work on the theory of numbers and other analytical subjects, *Disquisitiones Arithmeticæ*. Shortly afterwards his attention was attracted to astronomy; and he invented, and used in brilliant fashion, new methods for the calculation of the orbits of planets, comets, &c. The fruits of his researches in this department appeared, two years after his appointment as professor of Mathematics and director of the observatory at Göttingen, in his *Theoria Motus Corporum Cœlestium* (1809). He also laboured with equally brilliant success in the science of geodesy, being appointed by the Hanoverian government to conduct the trigonometrical survey of the kingdom and to measure an arc of the meridian. Whilst engaged in this work he invented the instrument then called heliotrope (see HELIOGRAPHY). Later in life (in 1843–46) he published a collection of valuable memoirs on surface geometry, in *Ueber Gegenstände der höhern Geodäsie*. In the meantime he had also begun to study the problems arising out of the earth's magnetic properties. In 1833 he wrote his first work on the theory of magnetism, *Intensitas Vis Magneticæ Terrestris*; and in conjunction with W. E. Weber he invented the declination needle and a magnetometer. He was also mainly instrumental in founding a Magnetic Association, which published valuable papers, entitled *Resultate* (1836–39), including two by Gauss on the law of magnetic attraction. In applied mathematics he investigated the problems connected with the passage of light through a system of lenses, in *Dioptrische Untersuchungen* (1840). Besides the researches already mentioned he wrote papers or works on probability, the method of least squares, the theory of biquadratic residues, constructed tables for the conversion of fractions into decimals and of the number of classes of binary quadratic forms, and discussed hypergeometric series, interpolation, curved surfaces, and the projection of surfaces on maps, all of which, with others, are printed in the seven vols. of his collected works (Gött. 1863–71). Gauss died at Göttingen, 23d February 1855. See Lives

by Sartorius von Waltershausen (2d ed. 1877) and Winnecke (1877).

Gaussen, FRANÇOIS S. R. LOUIS, a Swiss Reformed theologian, born at Geneva, 25th August 1790, was pastor at Satigny near Geneva, and took an active part in the church controversies of the time, until dismissed in 1831 by the State Council of Geneva, because he, with Merle d'Aubigné, had taken part in establishing the Société Évangélique, one object of which was the founding of a new theological school for the maintenance of the old Calvinism. From 1836 till his retirement in 1857 he lectured with success in the new college, and died at Les Grottes, Geneva, 18th June 1863. Of his writings may be named *La Theopneustie, ou Pleine Inspiration des Saintes Écritures* (1840), a defence of plenary inspiration, which became popular in England and America; and *Le Canon des Saintes Écritures au double point de vue de la Science et de la Foi* (1860).

Gautama. See BUDDHISM.

Gautier, THÉOPHILE, one of the most accomplished of recent French poets and prose-writers, was born at Tarbes, August 31, 1811, and educated at the grammar-school of his native town, and afterwards at the Collége Charlemagne in Paris. He applied himself at first, but without much success, to painting, turned to literature, and attracted the notice of Sainte-Beuve at eighteen by the style of several essays, the results of his studies in the earlier French literature. He soon attached himself to the school of Victor Hugo, and outdid all the other romanticists in the extravagance of his admiration and partisanship. His belief in the 'poet of the wind, the sea, and the sky' was the one serious belief of his life. In 1830 he published his first long poem, *Albertus*, an extravagantly picturesque legend, full of the promise of his later flexibility of diction, followed in 1832 by the striking *Comédie de la Mort*. But his poetry did not reach its highest point till the *Émaux et Camées* (1856). In 1835 appeared his celebrated novel, *Mademoiselle de Maupin*, with its defiant preface, which was taken seriously by the critics, instead of being regarded as merely the escapade of an unscrupulously clever youth, and the advertisement of a publisher who wanted a 'sensational' novel. He wrote many other novels and shorter stories, the chief being *Les Jeune-France* (1833), *Fortunio* (1838), *Une Larme du Diable* (1839), *Militona* (1847), *La Peau de Tigre* (1852), *Jettatura* (1857), *Le Capitaine Fracasse* (1863), *La Belle Jenny* (1865), and *Spirite* (1866). Mérimée alone contests with him the palm as the prince of writers of short stories. He was drawn early to the lucrative task of *feuilleton* writing, and for more than thirty years contributed to the Paris newspapers criticisms on the theatre and on the salon. The first half of his theatrical criticisms were collected in 1859 in 6 volumes, under the ambitious title of *L'Histoire de l'Art Dramatique en France;* his accounts of the Salon, which have yet to be republished, form perhaps the best history, if the least didactic, of modern French art. His leisure he devoted to travels in Spain, Holland, Turkey, England, Algeria, and Russia, of which he published characteristic accounts in his *Caprices et Zigzags, Constantinople, Voyage en Russie,* and *Voyage en Espagne,* admirable feats of description, relating solely to the look of the countries visited, not at all to their institutions, yet forming perhaps the most delightful books of travel in existence. Gautier died in Paris, October 23, 1872. Other works were an enlarged edition of his inimitable *Émaux et Camées* (1872); *Les Grotesques* (1844), on the writers of the 16th and 17th centuries; *Honoré de Balzac* (1858); *Ménagerie Intime* (1869); a kind of informal autobiography; *Histoire du Romantisme* (1872); and the posthumous works, *Portraits et Souvenirs Littéraires* (1875), and *L'Orient* (1877). Gautier's name has become a kind of watchword and battle-cry. Writers with more enthusiasm than good sense have made him an idol, and elevated the paradoxes of his scepticism into a theory of life, while the sturdy moralists of the press use his name as a synonym for everything in art that is effeminate, and for all the affectations of the boudoir poetaster. The truth is that Gautier was nothing greater or less than a consummate artist in prose and verse. He is neither moral nor immoral; has absolutely no fixed faith of any sort, except in the pleasantness of pleasant impressions, holding even his æsthetic principles with good-humoured laxity. His whole philosophy is a philosophy of paradox, his ideal of life hardly more than a picturesque viciousness. His besetting sin was a childish desire to say something clever and wicked to shock the Philistines. He himself never expected his lewd romance to be taken seriously, to be adopted as the gospel of a school, and characterised with grave absurdity as 'the golden book of spirit and sense.' See the collections of reminiscences by Ernest Feydeau (1874) and Bergerat (1878); also Henry James's *French Poets and Novelists* (1878).

Gauze, a light transparent silk fabric, supposed to have derived its name from having first been manufactured in Gaza, a city of Palestine. France and Switzerland produce large quantities. The openness of texture is obtained by crossing the warp threads between each thread of the weft, so that the weft passes through a succession of loops in the warp, and the threads are thus kept apart, without the liability to sliding from their places, which would take place if simple weaving were left so loose and open. It is used for dress purposes, and largely also for sifting flour. What is made for the latter purpose is sometimes called bolting-cloth. The cotton fabric *leno* has the same structure as gauze. Cheap textiles of the nature of gauze are used for the dresses of ballet-girls. For wire-gauze, see WIRE CLOTH.

Gavarni, PAÜL, a French caricaturist whose proper name was Sulpice Guillaume Chevalier, was born at Paris in 1801, and started life as a mechanical engineer. But, being a skilful draughtsman, he abandoned engine-making to become a caricaturist for *Les Gens du Monde,* and afterwards for *Le Charivari.* During the early part of his career he ridiculed the follies, vices, and habits of the citizens of Paris with a sort of good-humoured irony; but later in life a deeper earnestness, and sometimes even bitterness, showed itself in the productions of his pencil. This tendency was greatly strengthened by a visit to London in 1849, and from that date he reproduced in the newspaper *L'Illustration* the scenes of misery and degradation he had witnessed in the English capital. Gavarni also illustrated several books, the most notable being Sue's *Juif Errant,* Balzac's works, the French translation of Hoffmann's tales, &c. He died at Auteuil, near Paris, 23d November 1866. A collection of his drawings, engraved on wood, appeared at Paris, under the title of *Œuvres Choisies,* with text by Janin, Gautier, Balzac, and others (4 vols. 1845–48). This was followed by a second collection, *Perles et Parures* (2 vols. 1850).

Gavazzi, ALESSANDRO, a popular Italian preacher and reformer, was born at Bologna in 1809. He became a monk of the Barnabite order, and was appointed professor of Rhetoric at Naples, where he speedily acquired great reputation as an orator. On the accession of Pius IX. to the papal chair, Gavazzi was one of the foremost supporters of the liberal policy that inaugurated that pontiff's

reign; and having repaired to Rome, he devoted himself to the diffusion of political enlightenment and patriotic aspirations among the masses of the Roman population. The pope sanctioned his political labours, and appointed him almoner of a body of 16,000 Roman troops. On the establishment of the republic at Rome, he was appointed almoner-in-chief to the national army. Under his superintendence, efficient military hospitals were organised. Rome having fallen, Gavazzi escaped to England, where he delivered addresses and lectures. He separated from the Catholic Church, and was for the rest of his life a strenuously anti-papal advocate. From Scotland the Italian orator proceeded to the United States, where he was rather coldly received; and when he went to Canada his public appearances, on more than one occasion, nearly caused a riot. Gavazzi was present with Garibaldi at Palermo during the expedition of 1860. He again visited London in 1870; and after that repeatedly visited England and Scotland, preaching and lecturing in aid of the (Protestant) Italian Free Church (*Libera Chiesa*), of which he was a prominent leader. He died 9th January 1889.

Gavelkind. The origin of this legal term is involved in some obscurity, and more than one derivation has been given. Lord Coke's opinion was that it was derived from *gave all kinde* (Teut. *gif eal cyn*), meaning the custom which gives right of succession in land to all children equally. The better opinion, however, seems to be that it is derived from the Saxon word *gavel* (or *gafol*), which signifies rent or customary services in lieu thereof, and *kind*—i.e. nature or quality. Thus gavelkind was used to express land which paid this kind of rent-service, as distinguished from the ordinary feudal tenure of knight-service. It is the opinion of Blackstone, endorsed by Skeat, that the true origin of this custom is Celtic (Irish, *gabhailcine*), while some recent investigators—as Elton in his *Origins of English History* (1881)—think that we must look for its source even farther back in pre-Aryan times.

Before 1066 gavelkind prevailed all over England and Wales (see Stephen's *Com.* i. 213), but with the Norman Conquest came feudal laws, and the right of primogeniture took its place. At the present day it survives only in the county of Kent and a few isolated places in England. It was specially abolished as regards Wales by 34 and 35 Henry VIII. chap. 26. In Kent, however, the custom is so universal that it is presumed by the courts of law to exist in any question affecting Kentish lands, and it is necessary in such case to plead that the lands have been disgavelled by special act of parliament. The reason why the county of Kent should have been permitted to retain this ancient tenure as one of its 'liberties,' in view of the almost universal introduction of feudal rules into the rest of England, is not clear. There is an explanation of a legendary character that William the Conqueror owed his life to some Kentish men, who immediately after the battle of Hastings surrounded him with boughs so as to form a sort of moving wood, and that he out of gratitude thereupon confirmed their ancient rights to them and their fellows.

The main characteristic of the tenure of gavelkind is that succession to the land passes in the right line to all the sons equally and not to the eldest son. Failing sons, it goes to all the daughters as heirs-portioners. Further, the right of representation takes place, so that, if one of several sons should die, his issue (daughters in this event equally with sons) take in his place. Succession in the collateral line is similar; for, if one brother die, the succession passes to all his brothers equally and their issue *jure representationis*. In addition to these peculiarities in the matter of succession, the following features of gavelkind tenure may be noticed: (1) A wife takes by way of dower one-half instead of one-third of the land, and a husband becomes tenant by courtesy of one-half of the land (whether issue have been born or not) so long as he remains unmarried; (2) the tenant is of age sufficient to make a contract or alienate his estate by feoffment at the age of fifteen; (3) the gavelkind lands did not formerly escheat in case of an attainder for felony, the maxim being 'the father to the bough, the son to the plough;' but all lands now stand in the same position in this respect (Williams, *On Real Property*, 130).

Gaveston, PIERS DE. See EDWARD II.

Gavial (*Gavialis*), a genus of reptiles of the Crocodile (q.v.) order, conspicuously differing from true crocodiles and from alligators in the great length and slenderness of the snout. The teeth are very numerous, about 120; they are more equal in size than those of the other animals of this order.

Gavial (*Gavialis gangeticus*).

The best-known species, *G. gangeticus*, inhabits the Ganges. It attains a length of 24 feet; but, owing to the slenderness of its snout, it is esteemed less dangerous than a true crocodile of smaller size. The gavial feeds chiefly on fishes and carcasses, and preys more casually upon mammals. A cartilaginous swelling at the extremity of the muzzle seems to have given rise to Ælian's statement that the crocodile of the Ganges had a horn at the tip of its snout. In some parts—e.g. Malabar, the gavial is held sacred, worshipped, and petted. A smaller species from Borneo and Java is distinguished as *G. schlegelii*. See CROCODILE.

Gavotte, a French dance of a lively yet dignified character. The name is said to be derived from the Gavots, the people of the *pays de Gap*. The music is in common time, moderately quick, and always begins on the third beat of the bar; each of the two sections of which it consists is usually repeated. It is frequently introduced in the Suites (q.v.) of the elder classical composers (Bach, &c.); and recent imitations of this and other old dances are so numerous as to become wearisome.

Gay, JOHN, the youngest son of William Gay of Barnstaple, was born in 1685. Although of an old family, his father was in reduced circumstances; and Gay, after being educated at the local grammar-school, was apprenticed to a London silk-mercer. Disliking this occupation, he soon abandoned it, and, having spent some months at home, returned to London to live by letters. In 1708 he published his first poem, *Wine*, in blank verse, and in 1711

an anonymous pamphlet, called the *Present State of Wit*. By this time he had made the acquaintance of Pope, to whom in 1713 he dedicated a georgic, *Rural Sports*. Late in the previous year he had been appointed secretary to the Duchess of Monmouth. In 1714 he brought out *The Fan*, and following this, *The Shepherd's Week*, a contribution to Pope's crusade against Ambrose Philips. Subsequently, resigning his post with the Duchess of Monmouth, he accompanied Lord Clarendon, then envoy to Hanover, as secretary. At Anne's death he was again in London, endeavouring to conciliate fortune by an epistle to the newly-arrived Princess of Wales. His next effort was the *What d'ye Call It?* 'a tragi-comi-pastoral farce' (1715). *Trivia*, a clever picture of town life from a pedestrian's point of view, for which Swift supplied hints, came next; and later he bore the blame of *Three Hours after Marriage* (1717), a play in which Pope and Arbuthnot had the larger part. In 1720 he published his poems by subscription, clearing £1000. With this his friends hoped he would have made some provision for the future, but it apparently vanished, as did also some South Sea stock which had been presented to him, in the crash of 1720. In 1724 he produced *The Captives*, a tragedy, and three years afterwards the first series of his popular *Fables*. But his greatest success was *The Beggar's Opera*, the outcome of a suggestion for a 'Newgate pastoral' made by Swift as far back as 1716. Its popularity was extraordinary; it ran sixty-two nights, gave celebrity to its actors, and, in the popular phrase, made Rich (the manager) gay, and Gay (the author) rich. By the thirty-sixth night he had netted between £700 and £800; and he forthwith set about a sequel, *Polly*, which was prohibited. This step only served to give the play a greater sale in book form, and the subscriptions brought Gay £1200. After this he lived chiefly with the Duke and Duchess of Queensberry, who since 1720 had been the kindest of his many patrons. In 1732 he came from their house to London, probably in connection with his opera of *Achilles* (produced in 1733), was seized with an inflammatory fever, and died in three days (4th December 1732). He was buried in Westminster Abbey 'as if he had been a peer of the realm.'

As a man Gay was amiable, indolent, and luxurious. His health was bad, and he wasted his life in vain hopes of preferment. But no man made kinder friends; and that he retained them is proof of his personal charm. His *Fables* have still a faint vitality; folklorists and antiquaries still study *Trivia* and *The Shepherd's Week*, and 18th-century specialists delight in the chronicle of his two ballad operas. On the whole, however, his poetical reputation has not been maintained. But he was a charming song-writer, and will perhaps last longest by his ballad of 'Black-eyed Susan.' The best portrait of him is by Kneller's pupil, William Aikman.

Gaya, the chief town of Gaya district, in Bengal, on the Phalgu, 57 miles S. of Patna by rail. It is a place of the greatest sanctity, from its associations with the founder of Buddhism (q.v.), and is annually visited by about 100,000 Hindu pilgrims, who, under the guidance of the Brahman priests, pray for the souls of their ancestors at the forty-five sacred shrines within and without the walls. Gaya proper is the old town, where the Brahmans reside; adjoining, but distinct from it, is Sahibganj, the trading and European quarter, and seat of administration. Joint pop. (1881) 76,415.—The *district* has an area of 4712 sq. m., and a pop. (1881) of 2,124,682.

Gaya, the wine suburb of Oporto (q.v.).

Gayal (*Bibos frontalis*), a species of ox, which is found wild in the mountains of Aracan, Chittagong, Tipura, and Sylhet, and which has long been domesticated in these countries and in the eastern parts of Bengal. It is about the size of the Indian buffalo, is dark brown, and has short curved horns.

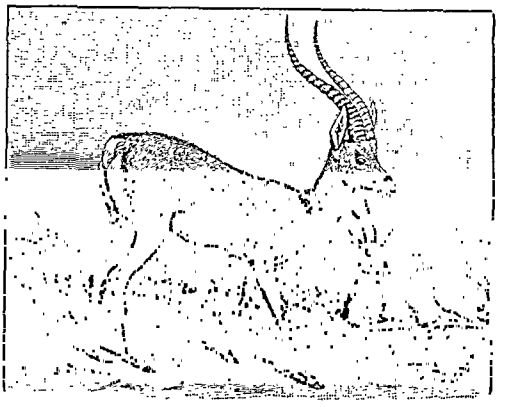
Gay-Lussac, LOUIS JOSEPH, chemist and physicist, was born 6th December 1778, at St Léonard (Haute Vienne). Entering the Polytechnic School in 1797, he was in 1800 promoted to the department of Ponts et Chaussées; and shortly afterwards Berthollet selected him as his assistant in the government chemical works at Arcueil. He now began a series of original researches on the dilatation of gases, the tension of vapours, the improvement of thermometers and barometers, the density of vapours, hygrometry, evaporation, and capillary action. Next, first with Biot, and a month later alone, he made two balloon ascents for the purpose of investigating the temperature and moisture of the air and the laws of terrestrial magnetism. Along with Alexander von Humboldt he analysed the properties of air brought down from a height of nearly 23,000 feet, and their joint memoir to the Academy of Sciences (read 1st October 1804) contained the first announcement of the fact that oxygen and hydrogen unite to form water in the proportion of one volume of the former to two volumes of the latter (see ATOMIC THEORY). This result induced him to study the combining volumes of other gases, and thus led him to the important discovery of the *law of volumes*, which was announced in 1808. A year later he was appointed professor of Chemistry at the Polytechnic School, and from 1832 also filled the corresponding chair in the Jardin des Plantes. Davy's discoveries of potassium and sodium, by the decomposing action of the voltaic pile, stimulated Gay-Lussac and Thénard to pursue this class of researches. The results appeared in their *Recherches Physico-chimiques* (2 vols. 1811). Amongst the most important of the discoveries announced in these volumes were a purely chemical process for obtaining potassium directly, the separation of boron from boracic acid, and new and improved methods of analysing organic compounds. (Boron was, however, simultaneously discovered in England by Davy.) Although the discovery of iodine (in 1811) is due to Courtois, Gay-Lussac shares with Davy the merit of having (in 1813) first described its distinctive properties, and proved that it is an elementary body; he was also the first to form synthetically the compounds of iodine with hydrogen and oxygen, known as hydriodic and iodic acids. In 1815 he succeeded in isolating the compound radicle Cyanogen (q.v.), the first known example of a compound body which will unite with elementary bodies in the same way as these unite with one another. Later in life he experimented upon fermentation, and in conjunction with Liebig made an examination of fulminic acid, and further improved the methods of organic analysis. From this time a good deal of his attention was given to the practical applications of chemistry. In this department his investigations regarding the manufacture of sulphuric acid (which led to the introduction of the Gay-Lussac tower, first erected by him for the recovery of waste oxides of nitrogen), his essays on the bleaching chlorides, his method of using the centesimal alcoholometer, and his improvements in assaying silver by the wet method by means of a standard solution of common salt, are the most important. In 1805 he was appointed a member of the Committee of Arts and Manufactures, established by the minister of Commerce, in 1818 superintendent of the government manufactory of gunpowder and saltpetre, and

in 1829 chief assayer to the mint. In 1839 he was made a peer of France. From the year 1816 he was the editor, in association with Arago, of the *Annales de Chimie et de Physique*. He died at Paris, 9th May 1850. As a chemist Gay-Lussac is distinguished by great accuracy, descriptive clearness, and undoubted genius. A complete list of his papers is given in the Royal Society's catalogue. His larger works, besides that already mentioned, include *Mémoires sur l'Analyse de l'Air Atmosphérique* (1804), *Cours de Physique* (1827), and *Leçons de Chimie* (1828).

Gaza (now called *Guzzeh*), one of the five chief cities of the ancient Philistines, situated in the south-west of Palestine, about three miles from the sea, on the borders of the desert which separates Palestine from Egypt. It is often mentioned in the history of Samson, and was the scene of constant struggles between the Israelites and the Philistines. In 333 B.C. it was taken after a five months' siege by Alexander the Great, and from that time down to 1799, when the French under Kleber captured it, it witnessed the victories of the Maccabees, the Calif Abu-bekr, the Templars, and the heroic Saladin. Constantine the Great, who rebuilt the town, made it the seat of a bishop. The modern Guzzeh is a collection of mere villages. It has no gates, no fortifications or defences of any kind. The only building of interest is the great mosque, with its tall octagonal minaret and peaked roof. Pop. 16,000.

Gaza, THEODORUS, one of the earliest to revive Greek learning in the West, was born at Thessalonica in 1398, fled about 1444 before the Turks to Italy, where he became teacher of Greek at Ferrara, next of philosophy at Rome. After the death of Pope Nicholas V., King Alfonso invited him to Naples; but the death of this new patron two years later drove him back to Rome, where he was befriended by Cardinal Bessarion, who obtained for him a small benefice in Calabria. There he died in 1478. Gaza has been warmly praised by subsequent scholars, such as Politian, Erasmus, Scaliger, and Melanchthon. His principal work was a Greek grammar in four books, first published by Aldus Manutius at Venice in 1495. He translated into Latin portions of Aristotle, Theophrastus, St Chrysostom, Hippocrates, and other Greek writers.

Gazelle is a name given to some twenty different species of antelopes, which differ from each other principally in the form of curvature of the horns, in the presence or absence of horns in the female, and in the colour. The true gazelle (*Gazella Dorcas*) is a species about the size of a roebuck, but of lighter and more graceful form, with longer and more slender limbs, in these respects exhibiting the typical characters of the antelopes in their highest perfection. It is of a light tawny colour, the under parts white; a broad brown band along each flank; the hair short and smooth. The face is reddish fawn-colour, with white and dark stripes. The horns of the old males are 9 or 10 inches long, bending outward and then inward, like the sides of a lyre, also backward at the base and forward at the tips, tapering to a point, surrounded by thirteen or fourteen permanent rings, the rings near the base being closest together and most perfect. The horns of the female are smaller and obscurely ringed. The ears are long, narrow, and pointed; the eyes very large, soft, and black; there is a tuft of hair on each knee; the tail is short, with black hairs on its upper surface only, and at its tip. The gazelle is a native of the north of Africa, and of Syria, Arabia, and Persia. Great herds of gazelles frequent the northern borders of the Sahara; and notwithstanding their great speed, and the resistance which they are capable of making when compelled to stand at bay—the herd closing together with the females and young in the centre, and the males presenting their horns all around—lions and panthers destroy them in great numbers. The speed of the gazelle is such that it cannot be successfully hunted by any kind of dog, but in some parts of the East it is taken with the assistance of falcons of a small species, which fasten on its head, and by the flapping of their wings blind and confuse it, so that it soon falls a prey to the hunter.



Gazella Granti.

It is also captured in enclosures made near its drinking-places. Although naturally very wild and timid, it is easily domesticated, and, when taken young, becomes extremely familiar. Tame gazelles are very common in the Asiatic countries of which the species is a native; and the poetry of these countries abounds in allusions both to the beauty and the gentleness of the gazelle.—Some confusion has arisen among naturalists as to the application of the name gazelle, originally Arabic; and it has not only been given to the *leucoryx* of the ancients, a very different species, but even to the *gemsboc* of South Africa. The true gazelle was known to the ancients, and is accurately described by Ælian under the name *dorcas*, which was also given to the roe.

Gazette, an abstract of news, a newspaper. The word is derived, through the medium of French, from Italian *gazzetta*, 'a gazette,' which may have been originally a mere diminutive of *gazza*, 'magpie,' with the sense of 'gossip, tittle-tattle;' or, with greater likelihood, *gazzetta*, 'a small coin' (Gr. *gaza*, 'a treasury,' a word ultimately of Persian origin), the sum charged for a reading of the first Venetian newspaper, which appeared about 1536. The *London Gazette* is an official organ, the property of the government. It was founded in 1665, and appears twice a week. It is recognised by law as the medium of official and legal announcements, as also of many intimations with regard to private transactions which are required by law to be thus published, such as trust-deeds for creditors. Similar official gazettes are published at Edinburgh and Dublin. To be 'put in the gazette' is in Britain a popular synonym for becoming bankrupt.

Gazetteer is in modern English a geographical or topographical dictionary, or alphabetical arrangement of place-names, with a more or less abundant complement of information, descriptive, statistical, and historical. The word (like the corresponding French *gazétier*) was familiar in the 18th century in the sense of a writer in the gazettes or newspapers. That industrious compiler, Laurence Echard or Eachard, published in 1703 *The Gazet-*

teer's or Newsman's Interpreter, being a geographical index of all the considerable Cities, Patriarchships . . . Ports, Forts, Castles, &c. in Europe. 'The *Title*,' he says, 'was given me by a very eminent person whom I forbear to name.' In the preface to the second part (1704), relating to Asia, Africa, and America, he refers to his book briefly as *The Gazetteer*. Other compilers soon adopted the convenient abbreviation. The word was new, but the thing was of ancient date—e.g. we still have considerable fragments of the 6th-century geographical dictionary of Stephanus Byzantius.

General Gazetteers.—The ideally perfect gazetteer would be one in which every place-name in the world was registered and its history recorded. To any one who knows what this would mean, the most extensive 'Universal' gazetteer must appear amusingly meagre. The following are among the noteworthy works of general scope: Ferrarius, edited by Baudrand (fol. Paris, 1670); Bryce of Exeter, *Univ. Geog. Dict. or Grand Gazetteer* (2 vols in 1, fol. Lond. 1759: a remarkable bit of work); Brooke (8vo, Lond. 1778; 16th ed. 1815); Walker, edited by Capper (8vo, Lond. 1815); Cruttwell (1798), afterwards incorporated in the *Edinburgh Gazetteer* (1 vol. 1822; 2d ed. 6 vols. 1829); Landmann (8vo, Lond. 1835); Macculloch (1841-42); Thomson (8vo, Edin. 1842); Fullarton (25,000 names; 7 vols. Edin. 1850); Blackie's *Imperial* (2 vols. Glasgow, 1850); Johnston (1850; new ed. 1877); Lippincott, *Pronouncing Gaz. of the World* (Phila. 1865; new ed., with 125,000 places, 1880); Bouillet, *Dict. d'Hist. et de Géog.* (1857); Knight's *Encyclopædia* (geog. division); Ritter's *Geog.-stat. Lexikon* (2 vols. Leip. 1874, edited by Henne am Rhyn; new ed. edited by Lagai, 1883); Saint-Martin, a vast work still in progress (4to, Paris, 1875, &c.); Oliver and Boyd (8vo, Edin. 1880); Metzger *Geog.-stat. Welt-Lexikon* (8vo, Stutt. 1888).

Special Gazetteers—

America (North).—*American Gazetteer* (3 vols. Lond. 1762); Thomson (4to, Lond. 1812); Davenport (8vo, New York, 1842); Kidder (Burley's, 8vo, Phila. 1876); Colange, *U.S. Gazetteer* (8vo, Cincinn. 1884).

Ancient Geography.—Echard (12mo, Lond. 1715); Macbean (8vo, Lond. 1773); Adam (8vo, Edin. 1795); Smith (2 vols. 8vo, 1852-57).

Australia.—Gordon & Gotch's *Australian Handbook, incorporating New Zealand, &c.* (20th annual issue, 1888).

Austria-Hungary. — Umlauft, *Geog. Namenbuch* (1885), and local lexicons issued by Statistical Commission.

British Empire.—Macculloch (1837); Knight (2 vols. 8vo, Lond. 1853).

Commercial.—Peuchet (6 vols. 4to, Paris, 1800); Macculloch (8vo, Lond. 1832; new ed. 1882).

Egypt (Ancient).—Brugsch (Leip. 1877-80).

England.—William Lambard (born 1536), the writer of the first county history, is also the author of the first gazetteer of England, though the work did not appear in print till 1730. *A Book of the Names of all Parishes, &c.* (4to, Lond. 1657); John Adams, *Index Villaris* (fol. Lond. 1680); Whatley, *England's Gazetteer* (3 vols. 12mo, Lond. 1751); Luckombe (3 vols. 12mo, Lond. 1790); Carlisle (2 vols. 4to, Lond. 1808); Capper (8vo, Lond. 1808); *Gorton* (3 vols. 8vo, Lond. 1831-33); Ball (8vo, Glasgow, 1832); Cobbett (8vo, Lond. 1832); *Parliamentary Gazetteer* (4 vols. 4to, Lond. 1842); Lewis (7th ed. 4 vols. 4to, Lond. 1849); Dugdale & Blanchard (8vo, Lond. 1860); Wilson (2 vols. 8vo, Edin. 1866-69).

France.—Few countries, if any, are more thoroughly gazetteered than France. It is enough to mention Gindre de Nancy (1874), Joanne (3d ed. 1886), and the great series of departmental gazetteers brought out by the ministry of Public Instruction (1861, &c.).

Germany.—Neumann, *Geographisches Lexikon des Deutschen Reiches* (Leip. 1883).

Great Britain.—Sharp (2 vols. Lond. 1863); Hamilton (3 vols. 4to, Lond. 1868); Beeton (8vo, Lond. 1870); Bartholomew (60,000 names, 8vo, Edin. 1887).

Holland.—Van der Aa (Gouda, 1855); Heringa (Utrecht, 1874); Witkamp (1875).

India.—Hamilton (8vo, Lond. 1815); Thornton, *Gaz. of the Countries adjacent to India on the N.W.* (2 vols. 1844); Thornton, *Gaz. of the Territories under the E. I. Company* (4 vols. 1854; 1 vol. 1857, new ed. by Sir Roper Lethbridge and A. N. Wollaston, 8vo. 1886); Hunter, *Gaz. of India* (20 vols. 8vo, 1875-77; 2d ed. 1885-87). Numerous gazetteers for the several states have been compiled at the cost of the government; some of them, as that on Afghanistan, are hardly obtainable.

Italy.—Zuccagni Orlandini, *Corografia* (15 vols. 1844, &c.); Repetti, *Diz. della Toscana* (6 vols. Flor. 1833-46); Amati (8 vols. Flor. 1868, &c.); Altavilla (8vo, Turin, 1875).

Ireland.—Seward (12mo, Dublin, 1789); Carlisle (4to, Lond. 1810); Lewis (4to, Lond. 1837); Lawson (12mo, Edin. 1842); *Parliamentary Gazetteer* (3 vols. 8vo, Lond. 1844-46); Leggatt (8vo, Lond. 1879).

Russia.—Semenoff, in Russian (1862-86).

Scotland.—Macpherson, *Geographical Illustrations of Scottish History, containing the names mentioned in Chronicles, &c.* (4to, Lond. 1796); *Gazetteer* (8vo, Dundee, 1803; 2d ed. Edin. 1806); Carlisle (2 vols. 4to, Lond. 1813); Webster (8vo, Edin. 1817); Chambers (8vo, Edin. 1832); *Topographical . . . Gazetteer* (2 vols. 4to, Glasgow, 1842); *Comprehensive Gazetteer* (12mo, Glasgow, 1846); Wilson (2 vols. 8vo, Edin. 1854-57); *Ordnance Gaz.* (edited by F. H. Groome, 3 vols. 8vo, Edin. 1882-85).

Spain.—Madoz (1846-50), Mariana y Sanz (1886).

Sweden.—*Hist.-geog. Lex.* (8vo, 7 vols. Stockholm, 1859-66); Rosenberg (1881-83).

Switzerland.—Weber (2d ed. 1886).

Compare articles on the several countries.

Gazogene. See Aerated Waters.

Gearing, a term applied to the machinery which communicates motion from one part of a machine to another, and may consist of toothed-wheels, endless bands, &c. When the communication is interrupted, it is *out of gear;* and when restored, *in gear. Straight gearing* is used when the planes of motion are parallel; *bevelled gearing,* when the direction is changed. Gearing may also be 'multiplying' or retarding—i.e. increasing or diminishing the original velocity. See Wheel.

Gebhardt, Oskar von, was born at Wesenberg in Esthonia, 22d June 1844, studied theology at Dorpat, Tübingen, Erlangen, Göttingen, and Leipzig, and since 1875 has been engaged as a librarian at Strasburg, Leipzig, Halle, Göttingen (1880), and Berlin (1884). He has edited *Patrum Apostolicorum Opera* (with Harnack and Zahn; 3 vols. Leip. 1875-78), *Evangeliorum Codex Rossanensis* (with Harnack; 1880), and *Texte und Untersuchungen zur Geschichte der altchristlichen Litteratur* (with Harnack; vols. i.-v. 1883-88). Since 1881 he has re-edited Tischendorf's text of the New Testament.

Gebir, or Geber. Under this name are current several works on alchemy and chemistry. The history of the real author is so shrouded in mystery that his existence has been denied, and Gebir looked upon as a mythical personage. He is usually identified with Jabir ibn Haijan, a celebrated Arabic alchemist in the 8th century. His birthplace is given differently as Harran in Mesopotamia, Tarsus, and Kufa; he is said to have resided at Damascus and Kufa, and to have died in 776. The principal writings which go under the name of Gebir, and several of which have been translated into English, are *Summa Perfectionis* (see Alchemy); *Summa Collectionis Complementi Secretorum Naturæ; Testamentum; Liber Investigationis;* and two tractates on spherical triangles and astronomy.

Gebweiler (Fr. *Guebwiller*), a town of Alsace-Lorraine, at the foot of the Vosges, 15 miles SSW. of Colmar, has a 12th-century church, cotton-spinning and weaving, dye-works, machine-factories, and vineyards. Pop. (1885) 12,395.

Gecko, a group of lizards constituting a family, Geckotidæ, which have been divided into a large number of genera, including more than 200 species. The geckos are of small size, the colours of most of them are dull, and the small granular scales with which they are covered are in general

mingled with tubercles. The legs are short, the gait usually slow, measured, and stealthy, although geckos can also run very nimbly when danger presses, and often disappear very suddenly when they seem almost to be struck or caught. The feet are remarkable, being adapted for adhering to smooth surfaces, so that geckos readily climb the smoothest trees or walls, or creep inverted on ceilings, or hang on the lower side of the large leaves in which tropical vegetation abounds. The body and tail are never crested, but are sometimes furnished with lateral membranes, variously festooned or fringed. The lateral membrane is sometimes even so large as to be of use to arboreal species in enabling them to take long leaps from branch to branch. The geckos feed chiefly on insects. They are more or less nocturnal in their habits. They are natives of warm climates, and

Fringed Gecko (*Ptychozoon homalocephalum*).

are very widely distributed over the world, being especially numerous in the Indian and Australian regions. Two species are found in the south of Europe, both of which frequently enter houses, as do the geckos of Egypt, India, and other warm countries. The name gecko is derived from a peculiar cry often uttered by some of the species, and which in some of them resembles syllables distinctly pronounced, whilst others are described as enlivening the night in tropical forests by a harsh cackle. The geckos have, in almost all parts of the world where they are found, a bad reputation as venomous, and as imparting injurious qualities to food which they touch; but there is no good evidence in support of any such opinion, in accordance with which, however, an Egyptian gecko is even known as 'the father of leprosy.'

Ged, WILLIAM, inventor of the art of stereotyping, was an Edinburgh goldsmith, who from 1725 onwards bent his energies to the Stereotyping (q.v.) of books. He entered into partnership with a London capitalist, and was commissioned by the university of Cambridge to stereotype some prayer-books and bibles, though only two prayer-books were actually finished; for, owing to the unfair treatment of his partner and the injustice of his own workmen, Ged was compelled to abandon the enterprise. He returned to Edinburgh a disappointed man, and died there on 19th October 1749. His most noteworthy production after his return home was a stereotyped edition of Sallust (1739). See Nichols's *Memoirs* (1781).

Geddes, ALEXANDER, a biblical critic, translator, and miscellaneous writer, was born at Arradowl, in the parish of Ruthven, Banffshire, in 1737. His parents were Roman Catholics, and he was educated for a priest, first at Scalan, a monastic seminary in the Highlands, next at the Scots College, Paris, where he acquired a knowledge of Hebrew, Greek, Italian, French, Spanish, German, and Dutch. In 1764 he returned to Scotland, and five years later took a cure of souls at Auchinhalrig in Banffshire, where he remained for ten years. Here he made himself conspicuous by a breadth of sympathy with the Protestants around him, so extraordinary as to lead to his being deposed from all his ecclesiastical functions. The university of Aberdeen made him LL.D. Geddes now resolved to betake himself to literature, and proceeded to London in 1780. He had long planned a translation of the Bible into English for the use of Roman Catholics, and he was now, through the munificence of Lord Petre, enabled to devote himself to the work. The first volume appeared in 1792; the second in 1793, carrying the translation as far as the end of the historical books; and the third was issued in 1800, containing his *Critical Remarks on the Hebrew Scriptures*. These volumes, especially the last, are startlingly heretical, and offended Catholics and Protestants alike. They exhibit as thorough-going Rationalism as is to be found in Eichhorn or Paulus, eliminating the supernatural element from the Scriptures; such stories as that of the Creation in Genesis being merely poetical or philosophical fictions, and such figures as Moses merely men who by a pious fraud contrived to add a divine sanction to mere human wisdom. These opinions naturally enough exposed Geddes to the charge of infidelity. He died in London, 26th February 1802. His poems, even *Bardomachia*, are now of no importance. See the Life by Dr Mason Good (1803).

Geddes, ANDREW, a painter, was born at Edinburgh in 1789. He began to study at the Royal Academy in London in 1807, and first exhibited in Edinburgh, producing successful pictures in 1808 and in 1810, in the latter year the 'Draught-players.' This, along with 'The Discovery of the Scottish Regalia,' exhibited at the Royal Academy, London, in 1821, and 'Christ and the Woman of Samaria,' are esteemed his best pictures, though he also excelled in portrait-painting. In 1831 he was elected an Associate of the Royal Academy of London, and died in 1844.

Geddes, JENNY, an obscure woman whose name is memorable in tradition from her having begun the riotous resistance to the introduction of a Service-book prepared by Laud into the Church of Scotland in 1637. The day fixed for this hated innovation was Sunday the 23d July, and an immense crowd filled the High Kirk of St Giles, Edinburgh, on the occasion. On Dean Hanna's beginning to read the collect for the day, Jenny Geddes, who kept a vegetable-stall in the High Street, threw her stool at his head, shouting: 'Deil colic the wame o' thee; out, thou false thief! dost thou say mass at my lug?' A great uproar at once arose, and both dean and bishop (David Lindsay) had to flee for their lives from the fury of the mob. This tumult proved the deathblow of the liturgy in Scotland. This famous exploit is unfortunately lacking in historical evidence beyond a fairly early and persistent tradition. Still Sydserf in 1661 mentions 'the immortal Jenet Geddes, princess of the Trone adventurers,' as having burned 'her leather chair of state'—evidently an object already famous—at the Restoration bonfires, and the story appears with name and full detail in Phillips' *Continuation of Baker's Chronicle*, published in 1660, the heroine being stated as 'yet living at the time of this relation.' An idle attempt has been made to set up a rival claimant in one Barbara Hamilton or Mein, but Jenny Geddes still

keeps her place among the *worthies* of Scottish history. The credulous may even see her stool in the Antiquaries' Museum at Edinburgh. See Dr Lees's *St Giles', Edinburgh* (1889).

Gedrosia. See BELUCHISTAN.

Geelong, a city of Victoria, is picturesquely situated on the south side of Corio Bay, 45 miles SW. of Melbourne by rail. It is well laid out, abounds in attractive shops, and has some handsome buildings. The river Barwon forms the southern boundary of the city, and 3 miles farther spreads into the Connewarre Lakes, falling into the sea at Point Flinders. The gold discoveries in 1851 added to the prosperity of Geelong, which had been incorporated as a town in 1849, and became a principal seat of the wool trade—the first woollen mill in Victoria being erected in Geelong. Alongside of the railway jetty the largest ships can load and discharge, and there are three other jetties for smaller vessels. Through the bar at the entrance to Corio Bay a channel has been dredged for the convenience of steamer traffic. The district is exceedingly fertile; the Barrabool Hills on the west bank of the Barwon are covered with farms and orchards, but the vineyards have been destroyed under the Phylloxera Act. Limestone and a kind of marble are found in the neighbourhood. There are various industries carried on, especially the manufacture of woollen cloths and paper, meat-preserving, tanning, rope-making, fishing, &c. The Exhibition Hall and general produce exchange, theatre, and assembly rooms combined, stands in the market-square. The city is lighted with gas; is supplied with water from Stony Creek reservoirs and the river Moorabool; and has two parks, botanical gardens, government buildings, a town-hall, a new post-office (1889), an excellent hospital, a chamber of commerce, mechanics' institute, grammar-school, and five newspapers. Corio Bay is a favourite bathing-resort; and on the eastern boundary of the town are extensive limestone quarries. Pop., including the suburbs, (1871) 22,618; (1889) 20,000, of whom 10,000 were within the municipal boundary.

Geelvink Bay penetrates 125 miles southward into the western arm of New Guinea. Its entrance, some 155 miles wide, is protected by several islands; its shores are well wooded, flat, and fertile, but unhealthy. The bay is separated by a narrow isthmus from the Alfura Sea on the south, and by a still narrower isthmus from M'Clure Gulf on the west.

Geestemünde, a seaport of Prussia, situated at the confluence of the Geeste with the Weser, immediately SE. of Bremerhaven, owes its importance to the docks and wharves constructed in 1857–63. It has also a school of navigation; imports petroleum, tobacco, rice, coffee, timber, and corn; and carries on various industries connected with shipping. Pop. 4796.

Geez, or GE'EZ. See ETHIOPIA.

Gefle, chief town of the Swedish län of Gefleborg, is situated on an inlet of the Gulf of Bothnia, 71 miles by rail N. by W. of Upsala. The port for Dalecarlia, Gefle ranks third among the commercial towns of Sweden, coming next to Stockholm and Gothenburg. Among the noteworthy buildings are the castle (16th and 18th century) and the town-hall. Gefle, which has been rebuilt since its destruction by fire in 1869, has a school of navigation, and carries on shipbuilding, the manufacture of sail-cloth, cotton, and tobacco, and fisheries. It carries on an active trade, the principal exports being iron, timber, and tar; whilst its imports consist chiefly of corn and salt. Pop. (1874) 16,787; (1887) 21,508.

Gegenbaur, KARL, German comparative anatomist, was born on 21st August 1826, at Würzburg, where he was educated, and where he taught until 1855. In this year he was called to a medical professorship at Jena, but from 1858 to 1873 he taught principally anatomy. Removing to Heidelberg in 1873, he has since that date continued to lecture on the same subject. His fame rests upon his *Grundriss der vergleichenden Anatomie* (2d ed. Leip. 1878), which was translated into English that same year by F. J. Bell and E. Ray Lankester. Besides this he has published *Lehrbuch der Anatomie des Menschen* (1883; 2d ed. 1885), and since 1875 has edited the *Morphologisches Jahrbuch*.

Gehenna, the Greek form of the Hebrew *Gehinnom*, or Valley of Hinnom. This valley, or rather narrow gorge, lies south and west of the city of Jerusalem. Here Solomon built a high place for Moloch (1 Kings, xi. 7), and indeed Gehenna seems to have become a favourite spot with the later Jewish kings for the celebration of idolatrous rites. It was here that Ahaz and Manasseh made their children pass through the fire 'according to the abomination of the heathen;' and at its south-east extremity, specifically designated Tophet ('place of burning'), the hideous practice of infant sacrifice to the fire-gods was not unknown (Jeremiah, vii. 31). When King Josiah came forward as the restorer of the old and pure national faith he 'defiled' the Valley of Hinnom by covering it with human bones, and after this it appears to have become 'the common cesspool of the city, into which its sewage was conducted to be carried off by the waters of the Kidron, as well as a laystall, where all its solid filth was collected. Hence, it became a huge nest of insects, whose larvæ or "worms" fattened on the corruption.' It is also said that fires were kept constantly burning here to consume the bodies of criminals, the carcasses of animals, and whatever other offal might be combustible. Among the later Jews *Gehenna* and *Tophet* came to be symbols for hell and torment, and in this sense the former word is frequently employed by Jesus in the New Testament—e.g. Mark, ix. 47, 48.

Geibel, EMANUEL VON, one of the most popular of modern German poets, was born at Lübeck on 18th October 1815. After his studies at Bonn he lived at Berlin, in the poetical circle of Chamisso, Gaudy, and Kugler; next went to Athens in 1838 as tutor in the family of the Russian ambassador, but returned to Lübeck two years later to work up the material he had collected in Greece, and to pursue his studies in Italian and Spanish literature. At the beginning of 1843 a pension of 300 thalers was bestowed upon him by the king of Prussia. Geibel now resided alternately at St Goar with Freiligrath, at Stuttgart, Hanover, Berlin, and Lübeck, till in 1852 he was appointed professor of Æsthetics in the university of Munich by the king of Bavaria—a post he retained till 1868, when he retired to Lübeck. He contributed translations from the Greek poets to the *Classische Studien* of Ernst Curtius (1840), and in the same year published his own *Gedichte* (100th ed. 1884), the beauty and religious tone of which made them at once great favourites with the Germans. The results of his Spanish studies were the *Spanische Volkslieder und Romanzen* (1843), which were followed by the *Spanisches Liederbuch* (1852), published in conjunction with Paul Heyse. In 1857 appeared his tragedy of *Brunehild*, and in 1864 his *Gedichte und Gedenkblätter*. In 1868 he published another tragedy called *Sophonisbe*. He died at Lübeck, 6th April 1884. His poems are distinguished by fervour and truth of feeling, richness of fancy, and a certain pensive melancholy, and have procured

him a popularity—especially among cultivated women—such as no poet of Germany has enjoyed since the days of Uhland. An edition of his *Gesammelte Werke* was published at Stüttgart in 8 vols (1883 *et seq.*). See Lives by Gaedertz (1885) and Litzmann (1887).

Geiger, ABRAHAM, a Jewish scholar, was born at Frankfort-on-the-Main, May 24, 1810. According to old rabbinical practice, his teachers were his father and elder brother, till he reached the age of eleven. After that he went to the gymnasium, next to the universities of Heidelberg and Bonn, devoting himself to philosophy and the oriental languages. His prize essay, *Was hat Mohammed aus dem Judenthum aufgenommen?* was published in 1833. In November 1832 he was called as rabbi to Wiesbaden, and there he devoted himself with great zeal and in a scientific spirit to Jewish theology, especially in its relation to practical life. In 1835 he joined with several able scholars in starting the *Zeitschrift für Jüdische Theologie*. In 1838 he was called as second rabbi to Breslau, and here he came into serious conflict with the more conservative Jews, but carried with him all men of learning and thought. From 1863 he officiated as rabbi at Frankfort, whence he was called in 1870 to Berlin. Here he died, 23d October 1874, editing from 1862 till the last the *Jüdische Zeitschrift*. Of his many books may be named his striking *Urschrift und Uebersetzungen der Bibel* (1857), and the elaborate history, *Das Judenthum und seine Geschichte* (1864–65). An *Allgemeine Einleitung*, and 5 vols. of *Nachgelassene Schriften*, were edited by his son in 1875. See his Life by Screiber (Löbau, 1880).

Geiger, LAZARUS, philologist, was born at Frankfort, 21st May 1829, studied at Bonn, Heidelberg, and Würzburg, and in 1861 became a teacher in the Jewish school at Frankfort. He died 29th August 1870. He wrote much on the relation of language and thought, affirming that without language man must have been without reason. His principal works are *Sprache und Vernunft* (1868–72), and *Ursprung der Sprache* (1869; 2d ed. 1878). See Lives by Peschier (1871) and Rosenthal (1883).

Geijer, ERIC GUSTAF, Swedish historian, was born at Ransäter, in Vermland, January 12, 1783. He was sent at sixteen to the university of Upsala, and in 1803 gained the prize awarded by the Academy of Stockholm for the best essay on the Swedish administrator, Sten Sture. From this period he devoted himself to the study of the history of his native country. Beginning to lecture at Upsala in 1810, he was shortly afterwards nominated to a post in the office of the National Archives; in 1815 he was elected assistant-professor, and in 1817 professor of History at Upsala. Geijer exercised a marked influence on the poetic no less than on the historical literature of Sweden. As early as 1810 he, along with several friends, founded the Gothic Society, in whose magazine, the *Iduna*, first appeared several of Geijer's best poems, and the early cantos of Tegnér's *Frithiof*. Great as is the value of Geijer's historical works, he unfortunately did not complete any one of the vast undertakings which he planned. Thus, of the *Svea Rikes Häfder*, or Records of Sweden (1825), which were to have embraced the history of his native country from mythical ages to the present time, he finished only the introductory volume. This, however, is a thoroughly good critical inquiry into the sources of legendary Swedish history. His next great work, *Svenska Folkets Historia* (3 vols. 1832–36), was not carried beyond the death of Queen Christina. To Geijer was entrusted the task of examining and editing the papers which Gustavus III. had bequeathed to the university of Upsala with the stipulation that they were not to be opened for fifty years after his death. They appeared in 1843–46. Geijer died at Stockholm, 23d April 1847. Of his other historical and political works we need only mention specially *The Condition of Sweden from the Death of Charles XII. to the Accession of Gustavus III.* (1838), and *Feudalism and Republicanism* (1844). Besides these he edited the continuation of Fant's *Scriptores Rerum Succicarum Medii Ævi* (1818–25), and Thorild's *Samlade Skrifter* (1819–25), and, along with Afzelius, a collection of *Svenska Folkvisor* (1814–16). During the last ten years of his life Geijer took an active part in politics; but, although his political writings possess great merit, the very versatility of his powers diverted him from applying them methodically to the complete elaboration of any one special subject. He was also known to his countrymen as a musician and composer of no mean order. His collected works were published by his son, with a biographical sketch (13 vols. 1849–56; new ed. 1873–75).

Geikie, ARCHIBALD, F.R.S., geologist, born at Edinburgh in 1835, and educated at the High School and university. In 1855 he was appointed to the Geological Survey; in 1867 became director to the Survey in Scotland; from 1870 to 1881 was Murchison Professor of Geology in Edinburgh University; and in 1881 was appointed director-general to the Survey of the United Kingdom, being at the same time placed at the head of the Museum of Practical Geology, London. He is the author of *Story of a Boulder* (1858); *Phenomena of the Glacial Drift of Scotland* (1863); *The Scenery of Scotland viewed in connection with its Physical Geology* (1865; 2d ed. 1887); *Memoir of Sir R. Murchison* (1874); and a *Text-book of Geology* (1882); besides numerous class-books, primers, &c. on geology.

Geikie, JAMES, LL.D., geologist, was born at Edinburgh in 1839, and received an education similar to that of his brother Archibald. Having served on the Geological Survey of Scotland from 1861 to 1882, he succeeded his brother as Murchison Professor of Geology in Edinburgh University. He is the author of *The Great Ice Age in its Relation to the Antiquity of Man* (2d ed. 1877); *Prehistoric Europe* (1881); *Outlines of Geology* (1886; 2d ed. 1888); a translation of *Songs and Lyrics by H. Heine and other German Poets* (1887); besides a large number of geological maps, sections, and memoirs published by the Geological Survey; and he has written the geological articles for the present edition of this work. He became F.R.S.E., 1871; F.R.S., 1875; LL.D. (St Andrews), 1877; D.C.L. (Durham), 1889; and is a Fellow of many learned societies at home and abroad.

Geiler von Kaisersberg, JOHANNES, a famous pulpit-orator of Germany, was born at Schaffhausen, 16th March 1455, studied at Freiburg and Basel, and in 1478 became preacher in the cathedral of Strasburg, where he died, 10th March 1510. Geiler von Kaisersberg was one of the most learned and original men of his age; his sermons, usually composed in Latin and delivered in German, are marked by great eloquence and earnestness, nor do they disdain the aids of wit, sarcasm, and ridicule. Of his writings, which have now become very rare, may be mentioned *Das Narrenschiff* (Lat. 1511; Ger. by Pauli, 1520), comprising 142 sermons on Sebastian Brandt's *Narrenschiff*; *Das Irrig Schaf* (1510); *Der Seelen Paradies* (1510); *Das Schiff der Pönitenz und Busswirkung* (1514); *Das Buch Granatapfel* (1511); *Christliche Pilgerschaft zum Ewigen Vaterland* (1512); and *Das Evangelienbuch* (1515). See the studies by

Ammon (Erl. 1826), Dacheux (Paris and Strasb. 1876), and Lindemann (Freiburg, 1877).

Geissler Tubes. See VACUUM TUBES.

Gela, an ancient city on the southern coast of Sicily, near the site of the modern Terranuova. It was founded by a colony of Rhodians and Cretans, 690 B.C., and grew so rapidly that as early as 582 it was able to found a colony at Agrigentum, which was soon to outstrip Gela itself (see GELON). Here Æschylus died and was buried, 456 BC., and here Apollodorus was born. In 280 its inhabitants were transplanted to Phintias.

Gelasius, the name of two popes.—GELASIUS I., an African by birth, succeeded Felix III. in 492, and was one of the earliest bishops of Rome to assert the supremacy of the papal chair, not only over temporal authority, but also over general councils of the church. He vigorously repressed Pelagianism, which was spreading in Dalmatia, renewed the ban of his predecessor against the oriental patriarch, drove out the Manichæans from Rome, and died in 496. There are extant a treatise of his against the Eutychians and Nestorians, *De duabus in Christo naturis*, several letters, and a *Codex Sacramentarius*.—GELASIUS II., formerly John of Gaeta, was educated at the Benedictine abbey of Monte Cassino, was cardinal and chancellor under Urban II. and Paschal II., and on the death of the latter in the June of 1118 was chosen pope by the party hostile to the Emperor Henry V. The imperial party at Rome under the Frangipani seized his person, but were forced to set him free by the menacing attitude of the mob. The new pope fled before the advancing imperial troops to Gaeta, where he first received his consecration, and whence he fulminated the thunders of excommunication against Henry V. and Gregory VIII., the antipope he had set up. Soon after he was able to return to Rome, but ere long had to betake himself for protection to France, where he died in the monastery of Cluny, early in 1119.

Gelatine, in Chemistry. Little is yet definitely known of the chemical nature of gelatine. It consists approximately of carbon 49·6, oxygen 25·4, nitrogen 18·3, and sulphur about 0·1 per cent. It is soluble in hot water, in acetic acid, and in cold sulphuric acid, and is insoluble in alcohol, ether, and other organic liquids; the aqueous solution is precipitated by tannic acid, chrome alum, and corrosive sublimate, but not by most acids, salts, or alkalies in dilute solution. Gelatine may be purified by dissolving it in water and pouring the solution into a large bulk of alcohol; the clot which forms consists of nearly pure gelatine, containing only a trace of ash. By dry distillation gelatine yields a quantity of carbonate of ammonia, and a foul smelling brown oil containing carbonate, sulphide and cyanide of ammonia, aniline, methylamine, picaline, and a number of pyridine bases. Gelatine solution dissolves lime and calcium phosphate much more freely than cold water, forming with the latter a definite compound, which probably forms part of the tissue of bones.

In Technology, the term gelatine, although usually applied to only one variety of the substance obtained by dissolving the soluble portion of the gelatinous tissues of animals, nevertheless properly belongs also to Isinglass (q.v.) and Glue (q.v.), which are modifications of the same material. Vegetable jelly is also analogous. Gelatine and glue signify the more or less pure and carefully prepared jelly of mammalian animals; but the term isinglass is only applied to certain gelatinous parts of fishes, which from their exceeding richness in gelatine, are usually merely dried and used without any other preparation than that of minute division for the purpose of facilitating their action.

Gelatine proper is prepared for commercial purposes from a variety of animal substances, but chiefly from the softer parts of the hides of oxen and calves and the skins of sheep, such as the thin portion which covers the belly, the ears, &c.; also from bones and other parts of animals. One of the best, if not the best of the varieties of gelatine manufactured in Great Britain, is the 'sparkling gelatine' of Messrs Cox of Gorgie, near Edinburgh, which is remarkable for its great purity and strength, or gelatinising power, and is purified by processes patented by them. The materials they use are carefully selected portions of ox only imported from South America. Another preparation, made by Mackay of Edinburgh from calves'-feet, is deserving of special mention.

The general method adopted with skin-parings or hide-clippings is first to wash the pieces very carefully; they are then cut into small pieces and placed in a weak solution of caustic soda for a week or ten days. When this process of digestion has been sufficiently carried on, the pieces of skin are then transferred to revolving cylinders supplied with an abundance of clean cold water, and afterwards are placed still wet in another chamber lined with wood, in which they are bleached and purified by exposure to the fumes of burning sulphur; they next receive their final washing with cold water, which removes the sulphurous acid. The next operation is to transfer them to the gelatinising pots. Water is poured in with the pieces, and kept at a high temperature by means of the steam in the cases surrounding the pots.

By this means the gelatine is quite dissolved out of the skin, and is strained off whilst still hot; it is poured out in thin layers, which as soon as they are sufficiently cooled and consolidated are cut into small plates, usually oblong, and laid on nets, stretched horizontally, to dry. It is then cut into shreds and is ready for market.

Another process, introduced by Mr Swineburne, consists in treating pieces of calfskin by water alone, without the soda and sulphur processes; the pieces, after simple washing, being transferred at once to the pots to be acted upon by the steam. Inferior gelatine is made from bones and other parts of animals; and it is understood that the enormous number of rats killed in the sewers and abattoirs of Paris are used by [illegible]. The French manufacturers [illegible] any others in clarifying these inferior gelatines, and they rarely make any others; they run their plates out very thin, which gives them greater transparency; and they colour them with most brilliant colours, and form very fine-rolled sheets, tempting the eye with an appearance of great delicacy and purity.

Gelatine should never be judged by the eye alone. Its purity may be very easily tested thus: soak it in cold water, and then pour upon it a small quantity of boiling water; if pure it will form a thickish, clear, straw-coloured solution, free from smell, but if made of impure materials it will give off a very offensive odour, and have a yellow gluey consistency. No article manufactured requires such careful selection of material and such nice and cleanly manipulation to ensure a good marketable character; and those anxious for purity should avoid all artificially coloured varieties, however temptingly got up, unless they are required for merely decorative purposes and not for food. Of late years the commercial uses have greatly increased. Gelatine is the foundation of the dry-plate system of photography, and by its means the science has been revolutionised and its capabilities extended to an extraordinary degree. To the

printing process as employed by Messrs Goupil of Paris and others the world is indebted for cheap and at the same time highly artistic copies of many admirable pictures. It is further very extensively used by druggists for coating pills and nauseous drugs, liquid and solid, which are thus rendered tasteless; and by confectioners for some kinds of sweetmeats. For the value of gelatine as food, see DIET; and for applications of gelatine to the purpose of book illustration, see ILLUSTRATION. See also PHOTOGRAPHY.

One of the qualities of gelatine is its power to form chemical combinations with certain organic matters; hence, when it is mixed and dissolved in a fluid containing such matters, it combines, and the compound is precipitated. It would appear that this combination, however, is threadlike in its arrangement, and that the crossing threads form a fine network through the fluid, which, in falling, carries down all floating substances that by their presence render the liquid cloudy; hence its great value in clarifying beer and other liquids. For this reason isinglass, which has been found the best gelatine for the purpose, is very largely consumed by brewers.

Various kinds of animal food are valued for the abundance of gelatine they contain, as the Trepang and Bêche-de-Mer (species of Holothuria), sharks' fins, fish-maws, ray-skins, elephant hide, rhinoceros hide, and the softer parts, all of which are luxuries amongst the Chinese, Japanese, Siamese, Malays, &c. Turtle-shells, or the upper and lower parts of the shield (*carapace* and *plastron*), constitute the callipash and callipee of the epicure, and form, in the hands of the experienced cook, a rich gelatinous soup. The fleshy parts of the turtle, calves' head and feet, and many other things might be enumerated as valuable chiefly in consequence of their richness in this material.

Gelderland. See GUELDERLAND.

Gelidium, a genus of *Algæ Florideæ* (see SEAWEEDS). *G. cartilagineum* and the allied *Gracilaria lichenoides* are said to be utilised in the building of the edible birds'-nests, so much prized by the Chinese (see, however, EDIBLE BIRDS'-NEST). These and allied species are largely used for food in the East, as yielding wholesome jellies.

Gell, SIR WILLIAM, English antiquary and classical scholar, was born at Hopton in Derbyshire in 1777. He was educated at Jesus College, Cambridge, graduating in 1798, after which he held for some time a fellowship at Emmanuel College. He devoted his time principally to antiquarian research and geographical studies, and published works on the topography of Troy (1804), Pompeii (4 vols. 1817–32), and Rome (1834); itineraries of Greece (1810), the Morea (1817), and Attica (1817), as well as a book on the *Geography and Antiquities of Ithaca* (1808), and a *Journey in the Morea* (1823). Of these works the best was that on the antiquities and topography of Pompeii. For some years after 1814 he was one of the chamberlains of Caroline, consort of George IV. He died at Naples, February 4, 1836.

Gellert, or KILLHART, the famous dog of Prince Llewellyn, which, left in charge of his infant child, after a desperate battle killed a wolf that had entered the house. The prince on his return, seeing the cradle overturned and the floor sprinkled with blood, thought the hound had killed his child, and at once plunged his sword into its side. A moment after he found the child safe under the cradle and the wolf lying dead, and saw too late the faithfulness of his dog. Gellert was buried under a tomb which stands to this day in the lovely village of Beddgelert, near the south base of Snowdon. The story is the subject of a beautiful ballad by the Hon. William-Robert Spencer (1769–1834), second son of the fifth Earl of Sunderland, who became also third Duke of Marlborough. He was the father of two colonial bishops, and the author of much fashionable poetry long forgotten, with this one ballad that will not die.

Welshmen not only show the grave of the faithful Gellert, but fix 1205 as the date at which he was given to the prince by his father-in-law. Unfortunately for them the story was long before current in Europe, with a snake instead of a wolf as the enemy. It is the first tale in the oldest Latin prose version of the *Seven Wise Masters*, entitled *Dolopathos*, written about 1184, and nearly a century before (about 1090), it had existed in *Syntipas*, a Greek version of the *Book of Sindibád*, the eastern prototype of the *Seven Wise Masters*. From the Latin *Dolopathos*, or from oral tradition, the story was taken into subsequent versions of the *Wise Masters*, and also into the *Gesta Romanorum*. It occurs also in the *Liber de Donis* of Etienne de Bourbon, who tells us that the grave was visited by the sick, and it reappears in the *Historia Septem Sapientum Romæ*, the parent of Wynkyn de Worde's *History of the Seven Wise Masters of Rome* (1505). The story of the Dog and the Snake thus occurs in all the western group of the *Book of Sindibád;* and of eastern texts or of versions derived from these, it is found in the Syriac, Persian, Greek, Hebrew, Latin (John of Capua's *Directorium Humanæ Vitæ*), and the old Spanish (translated from an old Arabic version now lost). It does not occur in the modern Arabic version (the Seven Vazirs), which is incorporated with the *Book of the Thousand and One Nights*. In the *Sindibád Náma* (written in 1374), a Persian metrical version, a cat is substituted for a dog. Again, in the *Panchatantra* version it is a mongoose or ichneumon that kills the snake; in the *Hitopadesa* it is a weasel. Dr Beal has translated a version from the *Vinaya Pitaka* of the Chinese Buddhist books (412 A.D.), itself said to be due to a much older Indian original, supposed to date from over 200 B.C. This Dr Beal considers the oldest form of the *Panchatantra* story. See vol. ii. of *Popular Tales and Fictions* (1887), by W. A. Clouston, who corrects some errors in the account in Baring-Gould's *Popular Myths of the Middle Ages.*

Gellert, CHRISTIAN FÜRCHTEGOTT, a German poet and moralist, was born July 4, 1715, at Hainichen, in the Erzgebirge, Saxony, and was educated at the university of Leipzig. After spending some years in teaching, in 1751 he received a professorship at Leipzig, where he lectured on poetry, eloquence, and morals, to large and enthusiastic audiences, until his death, 13th December 1769. His importance in German literature is due to the fact that around him gathered those who revolted against the pedantries and frigid formalities of Gottsched and his school, and thus pioneered the way for the more brilliant reaction of Goethe and Schiller. Gellert came to occupy this position partly on account of his writings, but more on account of his personal character. A man of sincere piety, a moral enthusiast, and with a genuinely good kind heart, he was beloved by his students, and they carried his authority beyond the walls of his lecture-room. His writings consist principally of *Fabeln und Erzählungen* and *Geistliche Lieder*, both sets great favourites from the simplicity and naturalness of their style, and, in the case of the latter, their unaffected piety. His *Sämmtliche Werke* appeared in 10 vols. in 1769–74; new ed. 1867. See his Life by Döring (1833).

Gellius, AULUS, a Latin author, who flourished in the 2d century of our era, and is supposed to have been born at Rome, and to have studied

philosophy at Athens, after which he practised law at Rome without abandoning his literary pursuits. His well-known work, the *Noctes Atticæ*, begun during the long nights of winter in a country-house near Athens, and completed during the later years of his life, is a collection of miscellaneous and ill-arranged matter on language, antiquities, history, and literature, in 20 books, of which the 8th is wanting. It contains many extracts from Greek and Latin authors no longer extant. The best edition is that of Hertz (2 vols. Berlin, 1883–85); see also the same editor's *Opuscula Gelliana* (1886).

Gelnhausen, a town of Prussia, stands on the Kinzig and on the slopes of a vine-clad hill, 26 miles NE. of Frankfort-on-the-Main. Here, on an island in the Kinzig, Frederick Barbarossa built an imperial residence (the 'Pfalz'); and in 1169 he conferred upon the village the freedom of the empire. After being transferred to the counts of Hanau in 1435, Gelnhausen began to decay. It has several old buildings, as the town-house, some towers, the Catholic church, 'princes' house,' &c. Pop. 3695.

Gelon, tyrant of Gela and afterwards of Syracuse, was a scion of a noble family of the former city, and contrived to become successor to Hippocrates, its tyrant, in 491 B.C. Six years later he made himself master of Syracuse also, which then became the seat of his government, and to which he transferred the majority of the inhabitants of Gela. His influence soon extended itself over the half of Sicily. Gelon refused to aid the Greeks against Xerxes, as they declined to comply with his demand that he should be appointed commander-in-chief. He became embroiled with the Carthaginians because of their attack upon his ally, Theron of Agrigentum, and defeated them in a great victory at Himera, on the same day, according to tradition, on which the Greeks won the battle of Salamis. The clemency and wisdom of Gelon rendered him so generally beloved that when he appeared unarmed in an assembly of the people, and declared himself ready to resign his power, he was unanimously hailed as the deliverer and sovereign of Syracuse. Gelon died in 478 B.C., and his memory was held in such respect a century and a half after, that, when Timoleon razed to the ground all the statues of former tyrants, those of Gelon alone were spared.

Gelsemium nitidum (*G. sempervirens*), the yellow or Carolina jasmine (nat. ord. Loganiaceæ), is a climbing plant of the Atlantic southern United States, having large, axillary, fragrant, clustered blossoms and perennial dark-green leaves. The dried rhizome and rootlets are used in medicine, and contain an alkaloid, gelsemine, $C_{11}H_{19}NO_2$, to which the plant owes its physiological action. When the powdered rhizome, or any of the pharmaceutical preparations made from it, is taken internally in medicinal doses there ensues a feeling of languor, with slight depression of the circulation and lowering in the frequency and force of the pulse. In larger doses it acts as an active poison, causing cardiac depression, muscular weakness, and marked disturbance of vision—wide dilatation of the pupil and frequently squinting and ptosis. The central nervous system in man is also affected, the gait becomes staggering, general sensibility is much impaired, the respiration is slow and laboured, and the bodily temperature is lowered. If death results it is from failure of respiration. A solution of the alkaloid applied directly to the eye causes dilatation of the pupil and paralysis of accommodation. In medicine gelsemium is used to reduce the temperature in malarial and other sthenic fevers; it is also used in neuralgia, rheumatism, pneumonia, pleurisy, and other inflammatory diseases.

Gelsenkirchen, a modern manufacturing town of Westphalia, 4 miles NW. of Bochum. It owes to coal and iron its rise from a mere village since 1860. Pop. (1880) 14,615; (1885) 20,289.

Gem, a term often used to signify a precious stone of small size, such as may be used for setting in a ring, or for any similar purpose of ornament; but sometimes by mineralogists in a sense which they have themselves arbitrarily affixed to it, for the purpose of scientific classification, as the designation of an *order* or *family* of minerals, generally hard enough to scratch quartz, insoluble in acids, infusible before the blowpipe, without metallic lustre, but mostly brilliant and beautiful. Among them are included some of the minerals which, in popular language, are most generally known as gems—ruby, sapphire, spinel, topaz, beryl, emerald, tourmaline, hyacinth, zircon, &c.—and some other rarer minerals of similar character; but along with these are ranked minerals, often coarser varieties of the same species, which are not *gems* in the ordinary sense of the word, as emery and common corundum, whilst diamond and some other precious stones, much used as gems, are excluded. See Streeter's *Precious Stones and Gems* (1879). While the term gem is thus used currently to denote jewels and precious stones, it is strictly applicable only to such hard and precious stones as have been worked by engraving. When the engraved design is sunk in the stone the gem forms an intaglio, signet, or seal, and when the subject is in relief the gem is a Cameo (q.v.). The rarer and more costly precious stones, such as the diamond, ruby, emerald, and sapphire, are seldom treated by engraving, because, in addition to the excessive difficulty of working them by engravers' methods, their value principally depends on their brilliance of sparkle and colour. The stones of the gem-engraver are almost exclusively the variously coloured, mottled, and banded varieties of chalcedony quartz, which are differently named according to the appearance they present. From the gem-engraver's point of view, the most important stones are carnelian, sard, chrysoprase, plasma, bloodstone, jasper, agate, and onyx. As these names indicate only differences of colour and shades, degrees of translucency, and alternations of bands, all of which characteristics merge into each other, they are incapable of precise definition. The banded stone, generally called Onyx (q.v.), is used as the principal material for cameo-engraving, the relief subject being worked in one coloured band or stratum on a ground of a different colour.

The art of gem-engraving developed from the customary use of seals among the ancient Egyptians and other early civilised communities of the East. In addition to abundant remains of seals of high antiquity, we have ample testimony to their important functions from numerous references in early literature. Thus, in Genesis, xxxviii. 18, we read that Tamar demanded of Judah his signet as a pledge; and Pharaoh, in investing Joseph with the office of principal minister, gave him his signet-ring as a token of authority. The early seals of the Egyptians were cut in the form of the scarabæus or sacred beetle, with the intaglio design engraved in a flat base; and in this form they were followed by the early Greeks and the Etruscans. Among the Chaldeans, Babylonians, and Assyrians the primitive seals took the form of cylinders, around

Fig. 1.—Carnelian Etruscan Scarabæus: Centaur and Deer.

which the intaglio device was engraved. An impression in soft clay or other medium was obtained from such seals by gently rolling the cylinder over the surface to be impressed. The earliest of such intaglios were cut in steatite, serpentine, and other comparatively soft stones; but these materials by degrees gave way to the harder and more enduring materials in which it was possible to sculpture fine details with great minuteness. The cylindrical signet of Darius I. of Persia, engraved in chalcedony, and preserved to the present day, is an example of the art at its highest development among the Asiatic monarchies.

From the nature of the subjects engraved on gems, and from the method in which they were mounted, it is evident that they soon came to be employed otherwise than as signets. Gems came to be worn as personal ornaments mounted in rings and in other settings, they were treasured as works of art, and they were treated as charms to avert evil and to win success and the favour of gods and men. For the breastplate of the Jewish high-priest, Moses was instructed to 'take two onyx stones, and grave on them the names of the children

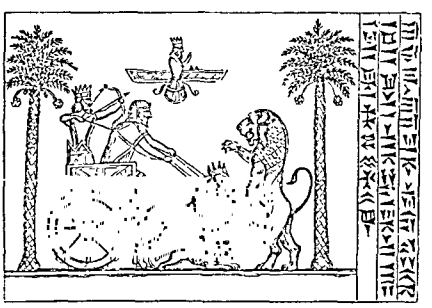


Fig. 2.—Chalcedony Cylinder: Signet of Darius I.

of Israel. . . . With the work of an engraver on stone, like the engravings of a signet, shalt thou engrave the two stones' (Exodus, xxviii. 9–11). With the extension of the uses of gems, the forms of the stones also changed; in the case of cylinders first into cones engraved on the base, then into hemispherical stones, ultimately taking a flat thin form through which the light would pass sufficient to show the engraving by transmitted light; and with this view the stones were sometimes convex and cut *en cabochon*. Ancient gems, like ancient coins, were generally irregular in outline, but at all times their prevailing form was oval.

The earlier engraved gems of the Greeks, as already mentioned, were in the form of scarabs. In these the engraved intaglio was enclosed in a guilloche or engrailed border, and the engraving was stiff and formal, in every respect like Etruscan work. Gem-engraving in Greece reached its highest perfection during the three centuries which preceded the Christian era, and the names of some of the most famous artists of that period have been handed down to the present day. In Rome the art was encouraged, and flourished till the period of the Antonines, after which it rapidly declined; and such Byzantine work as exists is rude in execution, and interesting only from the fact that with it Christian subjects begin to appear in gems. Cameo-engraving was *not* practised till the days of imperial Rome.

Fig. 3. Greek Sard, with Indian Bacchus.

The subjects of ancient gems embrace the whole circle of ancient art, and follow the laws of its development, animal forms being succeeded by those of deities and subjects derived from the battles of Greeks and Amazons and Centaurs, the exploits of Hercules and other heroes; then by scenes from tragedians and later myths; and finally by portraits, historical representations, and allegories. The inscriptions consist of the names of deities, heroes, and subjects; dedications to deities; the names of artists, sometimes in the genitive case, but often accompanied by the verb *epoei*, 'fecit;' addresses to individuals; gnomic or other sayings, indicating that the gems are amulets against demons, thieves, and various evils, or charms for procuring love; the names of the possessors, and sometimes addresses, occasionally even distichs of poetry, and various mottoes. These inscriptions were often added by subsequent possessors, and are not of the age of the gem itself.

With the decline of the arts generally, the art of gem-engraving sank during the middle ages, to be awakened again only through the patronage of the Medici family in Italy in the 15th century, and with varying fortunes it continued to be practised till the early part of the 19th century. Strictly classical models, and to a large extent classical subjects, have been chosen by modern engravers, and towards the end of the 18th century the practice of foisting modern imitations on buyers of gems as genuine Greek works of the best period became very prevalent. Prince Poniatowsky, who inherited a small collection of ancient gems from Stanislaus, last king of Poland, employed the most skilful engravers of his day to fill up his cabinet with imitation antiques on which the names of the most eminent engravers of antiquity were forged. The Poniatowsky forgeries did much to bring gem-engraving into disrepute, and to lower the value of even fine and undoubted works. The diagnosis of gems has been rendered a work of extreme difficulty; and, as the modern imitator possesses conveniences for his task which were not at the disposal of the ancient artist, works of high artistic merit and great finish are more likely to be modern than ancient.

In modern times a considerable trade has been carried on in the preparation of artificial gems, both cameos and intaglios, for jewelry purposes and for the cabinets of collectors. The most famous and successful maker of pastes was James Tassie, a native of Pollokshaws, near Glasgow, who in the latter half of the 18th century settled in London, and then, with marvellous industry, succeeded in copying upwards of 15,000 of the most famous and artistic gems of ancient and modern times. But Tassie's activity was not confined to the copying of gems alone. He produced in cameo a large series of portraits of his most famous contemporaries, and, while his whole productions are now highly prized, these large cameos are in great request, and command high and steadily-increasing prices.

Paste copies of existing gems are made with comparative ease, by obtaining an impression from the original in very fine moist Tripoli earth or rotten-stone, which mould is carefully dried. A piece of glass of the required colour and size is then laid over the mould, and placed in a furnace, which is raised to a heat sufficient to melt the glass, causing it to flow over and accurately fill the mould. When a cameo is being made, the raised portion alone is so moulded in opaque white glass, and, its back being ground flat and smooth, it is cemented to a mount of any desired colour. In some cases the mount itself is melted to the already formed relief portion, which for this purpose, after grinding away of the superfluous glass, is reintroduced into the furnace embedded in a Tripoli mould to allow of the mount being melted over it. Portrait cameos are made from wax models, casts

of which are taken in the same way as moulds are obtained from gems.

For the making of imitation gems or precious stones (engraved or not) from glass specially prepared and coloured, as well as for the production of actual but artificial precious stones by chemical methods, see STONES (PRECIOUS), as also DIAMOND, RUBY, PEARL, &c. For seals, see SEAL.

The chief implement used by the ancient engravers appears to have been made by splitting corundum into splints by a heavy hammer, and then fixing these points like glaziers' diamonds into iron instruments, with which the work was executed by the hand (*ferra retusa*). The drill, *terebra*, was also extensively used for hollowing out the deeper and larger parts of the work, and emery powder, the *smaris* or Naxian stone, for polishing. The so-called wheel, a minute disc of copper, secured to the end of a spindle, and moistened with emery powder or diamond dust, and driven by a lathe, does not appear to have come into use till the Byzantine epoch. It has been conjectured that the artist used lenses of some kind, or globes filled with water, to execute his minute work; but the ancient, like the modern engraver, rather felt than saw his way. All these processes were not employed by the same artist, for, besides the engraver (*scalptor cavarius, dactylioglyphus*), there was a polisher (*politor*), not to mention arrangers (*compositores gemmarum*), and merchants (*gemmarii, mangones gemmarum*) who drove a flourishing trade in emeralds and pearls and engraved stones in the days of Horace.

The principal writers of antiquity who treated of gems are Onomacritus or the Pseudo-Orpheus, Dionysius Periegetes, Theophrastus, and Pliny, whose chapter is compiled from antecedent Greek and Roman authors. Isidorus, 630 A.D., gives an account of the principal stones; so do Psellus and Marbodus in the 11th century.

See Mariette, *Pierres Gravées* (Paris, 1750); Raspe, *Descriptive Catalogue of Engraved Gems* (Lond. 1791); Millin, *Introduction à l'Étude des Pierres Gravées* (Paris, 1797); Krause, *Pyrgoteles* (Halle, 1856); King, *Antique Gems and Rings* (3d ed. 2 vols. 1872), and *Handbook of Engraved Gems* (2d ed. 1885); Bucher, *Gesch. der technischen Künste* (1875); Billings, *Science of Gems, &c.* (Lond. 1875); Pannier, *Les Lapidaires Français du Moyen Age* (Paris, 1872); Jones, *History and Mystery of Precious Stones* (1880); Gatty, *Catalogue of the Engraved Gems in the Collection of J. Mayer* (1879); *Catalogue of the Engraved Gems in the British Museum* (Lond. 1889).

Gemara. See TALMUD.

Gemini ('the Twins'), the third constellation in the zodiac. See CASTOR AND POLLUX.

Gemistus. See PLETHO.

Gemmation. See REPRODUCTION.

Gemmi Pass, a narrow path, nearly 2 miles long, which crosses the Alps at a height of 7553 feet, and connects the Swiss cantons of Bern and Valois.

Gemot. See FOLKMOOT, VILLAGE COMMUNITIES, WITENAGEMOTE.

Gems-bok (*Oryx Gazella*), a species of antelope, described by some naturalists as the Oryx, but which, being a native of South Africa only, cannot be the Oryx of the ancients, although it is certainly a nearly allied species. It is a heavy, stout animal, about the size of a stag, with rough reversed hair on the neck and along the ridge of the back; large pointed ears; and almost perfectly straight horns, fully two feet long, in the plane of the forehead, little diverging, and obscurely ringed at the base. The colours are harshly contrasted, dark rusty gray above, and white on the under parts, separated by a broad dark-brown or black band; the head white, with black transverse bands; the thighs black, and the legs white. The hoofs are

Gems-bok.

remarkably long, adapted to the rocky mountainous districts which the animal frequents. The Gems-bok makes such use of its horns as sometimes even to beat off the lion. It inhabits districts free from wood, and is generally found in pairs or in very small herds.

Genazzano, a small town of 4008 inhabitants, 27 miles E. of Rome, containing an old castle of the Colonna family, and the far-famed pilgrimage-chapel of the Madonna del Buon Consiglio. See *The Virgin Mother of Good Counsel*, by Dr G. F. Dillon (1885).

Gendarmes (Fr., 'men-at-arms') were originally mounted lancers, armed at all points, and attended by five inferior soldiers, who were furnished by the holders of fiefs; these were replaced by Charles VII.'s *compagnies d'ordonnance*, which were dissolved in 1787, one company of gendarmerie being retained as the bodyguard of Louis XVI. Since the Revolution, except for a short interval at the Restoration, the gendarmes have constituted a military police, which superseded the old *maréchaussée*, and comprises both cavalry and infantry; divided into legions and companies, and these latter into brigades, the organisation of the force corresponds to the territorial divisions of the army. The men receive much higher pay than the rest of the army, of which, however, the corps is a part, its members being drafted from the line for this service. Germany also since 1808 has had its *gendarmen*. See POLICE.

Gender, a grammatical distinction between words corresponding directly or metaphorically to the natural distinction of sex. Names applied to the male sex are said to be of the *masculine* gender; those applied to the female sex, *feminine*; while words that are neither masculine nor feminine are said to be *neuter* or of *neither* gender. In modern English we have no such thing as merely grammatical gender, save when sex is implied metaphorically to inanimate things (a ship, a steam-engine, &c.) by such a figure of speech as personification; but in Old English, as well as in Sanskrit, Greek, and Latin, the greater part of inanimate things are either masculine or feminine, the others being neuter; and this distinction of gender is marked by the terminations of the nominative and other case-endings. Grammatical gender went gradually out of use after the Norman

Conquest, the northern dialects being the earliest to discard it. In Hebrew there is no neuter, all names being either masculine or feminine, as also in the modern Romance tongues, Italian, French, Spanish, and Portuguese. German, again, in this particular resembles Old English and the classical tongues. See GRAMMAR.

Genealogy. See PEDIGREE.

General, or GENERAL OFFICER, is an officer of the general staff of the army. A field-marshal or general commanding-in-chief would in the field usually command several Army Corps (q.v.), a general one corps, a lieutenant-general one Division (q.v.), a major-general one Brigade (q.v.). Brigadier-generals in the British army are usually colonels in temporary command of brigades. There are many in India. In 1889 there were 5 field-marshals in the British army, 13 generals, 43 lieutenant-generals, and 117 major-generals. Comparatively few of these hold commands, and if unemployed for five years in either rank they are compulsorily retired. Also, a major-general must retire if he reaches sixty-two without being promoted, and a lieutenant-general or general at sixty-seven. Promotion amongst the generals is by seniority, unless there are good grounds for a contrary course, but promotion to field-marshal is made by the sovereign without respect to seniority. Colonels, if under fifty-five (sixty-two if holding temporary rank as major-general), and stated to be competent by the commander-in-chief, are eligible for promotion to general's rank, and the seniors are usually taken to fill vacancies as they occur; but at any time a colonel may be promoted for distinguished conduct.

As regards pay, when actively employed a general commanding-in-chief receives £10, 15s. a day; a general not in chief command, £8; a lieutenant-general, £5, 10s.; a major-general, £3; and a brigadier-general, £2, 10s., all exclusive of allowances for forage, &c. When on half-pay a field-marshal receives £1300 a year, the others £800, £650, and £500 respectively. When retired a general receives £1000 a year, a lieutenant-general £850, and a major-general £700; but there are various modifications affecting these amounts.

The rank of *captain-general*, superior even to field-marshal, is held by the sovereign *ex officio*, and is borne by the colonel of the Honourable Artillery Company of London, but otherwise it has not been conferred upon any officer of the British army during the 19th century.

In the United States the rank of general, a higher rank than had before existed, was created by act of congress in 1866, and conferred on General Grant. It was subsequently conferred on Sherman and on Sheridan. The highest rank held by Washington was that of lieutenant-general, which is also usually that of the general-in-chief of the army. There is, of course, but one lieutenant-general; and by law there can be but three major-generals and six brigadier-generals. The general's yearly pay is $13,500; the lieutenant-general's is $11,000; the major-general's, $7500; the brigadier-general's, $5500. In the militia there are ranks with like names, and the title of general as a form of address is consequently of embarrassing frequency in the United States.

General, in the Roman Catholic Church, the supreme head, under the pope, of the aggregated communities throughout Christendom belonging to a religious order (though the *abbas abbatum* of the Benedictines is not actually styled 'general'). The governing authorities of the monastic orders in the Roman Catholic Church may be arranged in three classes: (1) the superiors of individual convents or communities, called in different orders by the various names of abbot, prior, rector, guardian, &c.; (2) the provincials, who have authority over all the convents of a 'province'—the provinces being usually coincident in limit with kingdoms; (3) the general, to whom not only each member of the order, but all the various officials of every rank are absolutely subject. The general is usually elected, commonly by the general chapter of the order, which, in the majority of orders, consists properly of the provincials; with these, however, are generally associated the heads of the more important monasteries, as also the superiors of certain subdivisions of provinces. The office of general in most orders is held for three years. In that of the Jesuits it is for life; but in all the election of the general chapter must be confirmed by the pope. In most orders, too, there is assigned to the general a consultor (*admonitor*) or associate (*socius*), who, however, is only entitled to advise, and has no authority to control the superior. The general also is supposed to consult with and to receive reports from the various local superiors. He sends, if necessary, a visitor to inquire into particular abuses, or to report upon such controversies as may arise, and he holds a general chapter of the order at stated times, which differ according to the usage of the several orders. The general is exempt from episcopal jurisdiction, being subject to the immediate jurisdiction of the pope himself. He resides in Rome, where he enjoys certain privileges, the most important of which is the right to sit and vote with the bishops in a general council of the church. See MONACHISM, and the articles on the several orders.

General Assembly. See ASSEMBLY, GENERAL.

Generalisation is the act of comprehending under a general name a number of objects which agree in one or more points. These points are specially attended to by the process of Abstraction (q.v.), and are indicated by the common name. The result of generalisation is a common name or general term, which stands for the many objects in so far only as they all agree. This process is closely akin to classification and to definition; and the higher kind of generalisation is Induction (q.v.).

In logic the genus is a higher class which includes a lower, the lower one being the *Species* (q.v.); but the distinction is relative. That which is a genus in relation to its species is itself a species in regard to a higher genus. The genus has the larger Extension (q.v.), the species the larger intension. For the great question as to whether the genera and species have a *real* existence, see NOMINALISM. For genus in natural history, see GENUS.

Generation, a single succession in natural descent, the children of the same parents; in years three generations are accounted to make a century.

Generation, SPONTANEOUS. See SPONTANEOUS GENERATION.

Generations, ALTERNATION OF, an interesting complication in the life-history of many plants and animals, the organism producing offspring which are unlike itself, but which in turn give rise to forms like the original parents. Thus, a zoophyte buds off a swimming-bell, and the fertilised ova of the latter develop into the former. Early in the century the poet Chamisso, accompanying Kotzebue on his circumnavigation of the globe, called attention for the first time to the fact of alternation as observed in one of the locomotor tunicates (Salpa); the progress of marine zoology and the study of parasitic worms gave many natural-

ists glimpses of other alternations; but Steenstrup was the first to generalise the results in his work published in 1842, entitled 'On the Alternation of Generations; or the propagation and development of animals through alternate generations, a peculiar form of fostering the young in the lower classes of animals.' From hydroids and flukes he gave illustrations of the 'natural phenomena of an animal producing an offspring which at no time resembles its parent, but which itself brings forth a progeny that returns in its form and nature to the parent,' and distinguished the interpolated generation as the *Amme*, or 'wet-nurse.' His essay was sternly criticised by Owen in 1849, while Leuckart attempted to treat all the alternations as cases of metamorphosis. Criticism, however, has only rendered Steenstrup's generalisation more precise, and the observations of some of the foremost naturalists have shown that the phenomena are of wider occurrence than was at first supposed, though the form of the alternation varies widely in the different cases.

(*a*) *The Rhythm between Sexual and Asexual Reproduction.*—The simplest case to start with is that of many hydroids where a sessile, plant-like zoophyte—a colony of numerous nutritive 'persons'—produces in the summer months modified reproductive individuals which are set adrift as medusoids. These become sexual, and their fertilised ova develop into embryos which settle down and give rise to the sessile zoophyte from which we started. The life-history may be written in the formula:

$$\frac{M}{F}-A-\frac{M}{F}-A-\frac{M}{F}$$

(where M and F stand for male and female, and A for ase

The jelly-fish (Aurelia) (fig. 1, ontrast. From the

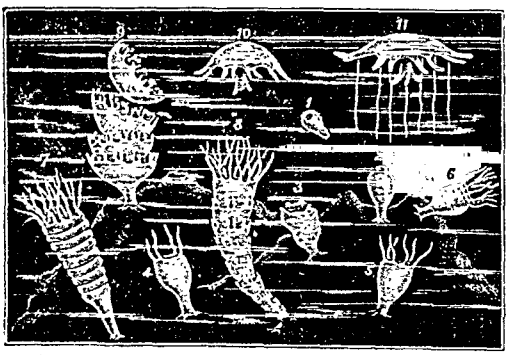
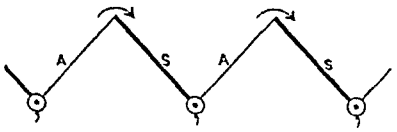


Fig. 1.—Life-history of the common Jelly-fish:
1, free-swimming embryo (*planula*); 2-6, the embryo fixed developing into a 'hydra-tuba,' which (7-8) divides transversely into a pile of individuals; these in turn (9) are liberated and grow (10-11) into jelly-fish. (From Haeckel.)

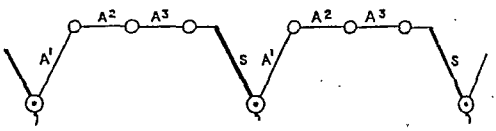
large free-swimming sexual jelly-fish embryos are produced which develop not into jelly-fish again, but into sessile tubular organisms or 'hydra-tubæ.'



A, asexual, produces S, sexual, from fertilised ovum of which A again arises.

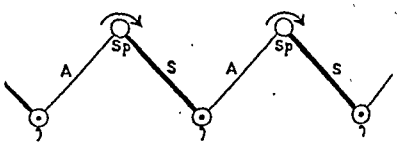
From these, by growth and division in an entirely asexual fashion, the jelly-fish are in turn reproduced. Here the sexual generation is the more stable and conspicuous—the reverse of the former case, but the same formula applies, or the preceding graphic notation. In the free-swimming Tunicata (Salpa and Doliolum) the alternation is somewhat more complex, but in no essential respect different.

(*b*) *Alternation between Sexual and Degenerate Sexual Reproduction.*—The life-history of the common liver-fluke, sketched in the article FLUKE, is in most cases as follows: From the fertilised ovum of the fluke an embryo develops, which produces several asexual generations, the last of which grow up to become sexual flukes. Now the asexual generations are not products of division or budding, but arise from what, though not ova, may be called precocious reproductive cells; in fact, they arise by a degenerate process of parthenogenetic reproduction in early life. The facts may be thus expressed:



where A^2 and A^3 represent two of the interpolated asexual generations.

This alternation between sexual reproduction by fertilised ova and reproduction by means of special cells which require no fertilisation prevails in many plants—e.g. ferns and mosses. From a fertilised egg-cell arises the ordinary fern-plant with which all are familiar. This, however, produces no male or female elements, but simply 'spores,' which are able of themselves (when they fall to the ground) to develop a new organism—the inconspicuous but sexual 'prothallus.' This bears male or female organs or both, and from the fertilised egg-cell thus produced the conspicuous vegetative, sexless fern-plant once more arises. The facts may be again expressed in notation:



A, the vegetative sexless fern-plant produces a spore (*sp.*) from which the sexual 'prothallus,' S, arises, giving origin to fertilised egg-cells, and thereby recommencing the cycle.

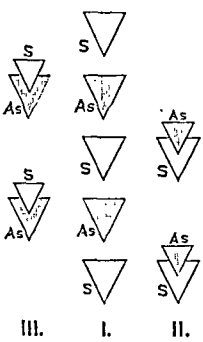
The same formula will apply to the moss. The familiar moss-plant bears male and female reproductive organs. From a fertilised egg-cell so produced a sexless spore-producing generation at once develops, and grows like a parasite on the apex of the moss-plant. The spores fall to the ground, and grow out into threads ('protonema'), from which there is finally budded the moss-plant with which we started.

Besides the above alternations there are other rhythms, some more complex, others much less frequent, into which we cannot here enter. In some cases the life-history of the liver-fluke, by the division of the embryo (sporocyst), combines the alternations (*a*) and (*b*); in some midge larvæ juvenile parthenogenesis alternates with the adult sexual process; in not a few cases, as in aphides, the rhythm is between parthenogenesis and normal sexual reproduction; while finally there is an alternation of two different *sexual* generations in three thread-worms or nematodes.

Occurrence.—Alternation of generations is hinted

at in the colonial Radiolarians, is definitely seen in the fresh-water sponge, is very characteristic of the Cœlenterates, prevails with curious complications in the flukes, is doubtful in tapeworms, occurs in one form in a few Nematodes and in certain Chætopods (Syllids), is represented by the rhythm between parthenogenesis and sexual reproduction in crustaceans and insects, and is very emphatic where it was first observed—in the locomotor tunicates.

In the lower plants, algæ and fungi, an alternation between spore-producing and truly sexual generations is frequent. In mosses and ferns it is almost constant, and yet more marked. Occasionally spore-formation or sex-cell formation may be suppressed, and the life-history thus simplified. In the flowering plants what corresponds to the sexual generation of a fern is much reduced; it has come to remain continuous with the vegetative asexual generation, on which it has had a subtle physiological reaction.



I. expresses ordinary alternation between sexual (S) and asexual (As) generations; in II. the asexual is increasingly subordinated to the sexual (as in mosses); in III. the sexual is subordinated to the asexual (as in flowering plants).

Hints as to Rationale.—The origin and import of the above rhythms, and their relation to the theory of heredity, are difficult problems. To some extent, however, it is easy to recognise that some of the alternations only express with emphasis the fundamental organic antithesis between nutrition and reproduction. A fixed hydroid—passive and well nourished, is preponderatingly vegetative and asexual; the reverse habit, the physiological rebound, finds expression in the actively locomotor sexual swimming-bell or medusoid. In the same way, though the alternation is less strictly between asexual and sexual, the contrast between the deeply-rooted, leafy, spore-bearing fern-plant and the inconspicuous, weakly-rooted, slightly-exposed, sexual prothallus is again fundamentally parallel. Alternation of generations is in fact an emphasised rhythm between the anabolic and katabolic tendencies so fundamental in the individual and racial life. To this, however, it will be necessary to return in the article REPRODUCTION.

See Steenstrup, 'On the Alternation of Generations' (Eng. trans. Ray Society, 1845); Owen's *Parthenogenesis* (1849); Haeckel's *Generelle Morphologie* (Berlin, 1866); Geddes and Thomson, *The Evolution of Sex* (Lond. 1889).

Genesee, a remarkable river rising in Pennsylvania, and flowing nearly 200 miles north through western New York into Lake Ontario, 7 miles N. of Rochester. The Genesee is famous for its extraordinary falls. Three of these occur within a distance of 1½ mile; two are respectively 68 and 90 feet high, and the Portage Falls are 110 feet high. The river has also a sheer fall of 95 feet at Rochester, utilised for water-power; and another cascade, a few miles below, is almost as high.

Genesis (Gr., 'origin,' 'generation'), the name given by the Septuagint to the opening book of the Pentateuch. In the Hebrew Bible it is named, from its first word, *Bereshith* ('in the beginning'). Critics are agreed that the book, like the rest of the Pentateuch, is a mosaic, drawn from various sources. A general description of these is already given in the section on the *Law and Historical Books* in the article BIBLE.

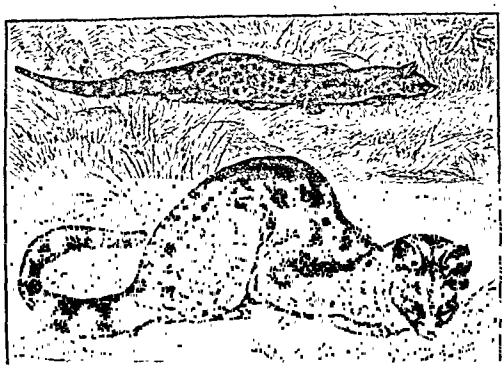
In Genesis the historical thread of the Priestly Code runs parallel to that of the Jehovistic element, which, in the view now prevailing, is the earlier of the two. The Priestly Code opens the book with its account of the creation of the world (i. 1—ii. 4*a*), which is immediately followed by the Jehovistic account (ii. 4*b*—iii. 24). After these are given, both in the Priestly narrative and the Jehovistic, the transition from Adam to Noah (iv. v.), the flood (vi.–ix.), and the transition from Noah to Abraham (x. xi.). In Genesis the Priestly narrative is a summary of facts mainly subordinated to the development of the theocracy. The history is broken into sections, each beginning with the words, 'these are the *generations* of,' &c. (cf. v. 1; vi. 9; x. 1; xi. 10, &c.), whence the name *Genesis* is derived. The whole is divided into three periods, each introduced by a covenant—(1) with Adam (i. 28—ii. 4); (2) with Noah (ix. 1–17); and (3) with Abraham (xvii.). Each covenant has its sign: the first has the Sabbath (ii. 3), the second the rainbow (ix. 12), the third circumcision (xvii. 10). These three periods and covenants lead up to the fourth period and covenant—viz. the Mosaic. The writer proceeds in an orderly and circumstantial manner, giving much attention to chronology, and, for the sake of clearness, sometimes repeating details more in the style of a lawyer than a historian (cf. vii. 13–16; viii. 15–19; xxiii. 17, 18, 20). The name for God used by him in Genesis is *Elohim* or *El Shaddai* (see Ex. vi. 3). The promises are by him confined to Israel, and have no reference to salvation through Israel for Gentiles (*cf.* xvii. 6–8; xxviii. 3, 4; xxxv. 11, 12).

The 'skeleton of ethnographic genealogy' which, in both narratives, is the foundation of the patriarchal history, is in the Jehovistic 'covered with flesh and blood.' Here the characters are living men, and their passions and actions are traced with the deep moral and religious inspiration and the marvellous epic vividness and force which give their imperishable charm to the stories of Genesis. And it is the prophetical narrative that shows how the Divine purpose included from the beginning a remedy for the world's sin (*iii. 15*), reveals the long-suffering mercy of the Divine mind (cf. viii. 21, 22; xviii. 23 *et seq.*), and prophesies that 'in Abraham's seed shall all the nations of the earth be blessed' (xii. 3; xviii. 18; xxviii. 14). For the distinction made between different parts of the *prophetical* narrative (less obvious than that between the prophetical narrative itself and the Priestly Code), see PENTATEUCH. How the conclusions of science have affected the literal faith in the descriptions of creation given in Genesis is shown in the article CREATION, and in Riehm, *Der biblische Schöpfungsbericht* (Halle, 1881).

See the Commentaries by Luther, Calvin, Rosenmüller (1821), Kimchi (edited by Ginsburg, 1842), Kalisch (Lond. 1858), Wright (*ib.* 1859), Cook and others (*ib.* 1871), Tuch (2d ed. by Arnold & Merx, 1871), Reuss, F. Delitzsch (4th ed. Leip. 1872), Lange (2d ed. 1877), Keil (3d ed. 1878), Dillmann (4th ed. 1882), and Dods (Edin. 1882). See also Knobel, *Die Völkertafel der Genesis* (Giessen, 1850); Wellhausen, *Prolegomena* (Eng. trans. 1885); and Driver's *Notes on Lessons from the Pentateuch* (New York, 1887).

Genette, or GENET (*Genetta*), usually regarded as a separate genus of carnivorous mammals, but by some included in the genus Civet (q.v.). The genettes differ from the civets in their smaller size, the vertically slit pupil, the completely retractible claws, the smallness of the anal pouch, and the faintness of the characteristic odour. Of six species of genette, five are found only in Africa; the common genette is found also in the south of

Europe and Syria. Its fur is gray with black or brown spots, and it is the only viverrine animal



Common Genette (*Genetta vulgaris*).

found in Europe. Genettes may be trained to catch mice liks cats.

Geneva, a canton in the south-west of Switzerland, is bounded N. by the canton of Vaud and the Lake of Geneva, and S., E., and W. by the territories of France. It has an area of 108 sq. m., and in 1880 had a pop. of 101,595, of whom 51,560 were Catholics, whilst 85 per cent. spoke French as their mother-tongue. It is watered by the Rhone and the Arve, which unite about 2 miles from the south-west extremity of the Lake of Geneva. The surface is hilly, chief eminences being the steep Salève (4528 feet) and the Reculet (5631); but the soil, which is not naturally fertile, has been rendered so by the industry of the inhabitants. According to the constitution of 1847, since amended, all male citizens of twenty years of age exercise the right of electing representatives to the cantonal council, the supreme legislative body, the age of members of which must be at least twenty-five years. There is a representative for every 1000 inhabitants. The executive is confided to a council of state composed of seven members, nominated for two years by universal suffrage. The constitution guarantees civil and religious liberty, all forms of worship being allowed by law; but the national church is the Reformed Calvinistic. Primary education is compulsory, but free. The chief branches of industry are gardening, vine and fruit growing, and the manufacture of articles of *bijouterie* and watches. In the two last-named branches the annual production is valued at nearly one million pounds sterling. Musical-boxes, chronometers, mathematical instruments, with pottery, &c., are also made. The chief town is Geneva.

Geneva (Fr. *Genève*, Ger. *Genf*, Ital. *Ginevra*), capital of the Swiss canton of the same name, is situated at the exit of the Rhone from the Lake of Geneva, 388 miles by rail SE. of Paris. A Gallic town originally, Geneva acknowledged Roman supremacy in 120 B.C. It was a place of some importance under the Burgundian kings, from whom it passed in 534 to the Franks, and from them towards the end of the 9th century to the new kingdom of Burgundy. It had been made a bishop's seat in the 4th century. From the 12th century a continual feud existed between the bishops and the Counts and Dukes of Savoy with regard to the supremacy—a state of things which the citizens took advantage of to obtain a considerable share of municipal liberty for themselves. Having secured Freiburg (1519) and Bern (1526) for allies, the republic of Geneva finally won its complete independence from Savoy. The acceptance of Protestantism by the republic a few years later brought to an end its alliance with the Roman Catholic republic of Freiburg, and exposed it to fresh attacks from the House of Savoy; and it was only saved by the timely intervention of its staunch ally Bern (1536). In the summer of that same year Calvin (q.v.) arrived at Geneva, and began his reconstitution of the political and social life of the city, which created it one of the chief strongholds of Protestantism in Europe. In 1602 the last attempt of the Dukes of Savoy to recover the town was frustrated by the citizens. During the 18th century Geneva was distracted by unceasing feuds between the aristocratic and popular parties, until in 1782 Bern, Sardinia, and, in particular, France interfered in favour of the aristocracy. The French Revolution led to a new crisis: the government was overthrown in July 1794, equality in the eye of the law was established, a national convention appointed, and a reign of terror commenced. In 1798 Geneva and its territory were annexed to France; but, after the overthrow of Napoleon, they recovered their independence and joined as twenty-second canton the Swiss Confederation under the sanction of the treaties of Vienna and of Paris (1815). The aristocratic party managed to repossess themselves of the government of the city, and their rule was only superseded by a more democratic constitution after much agitation and several risings of the people between 1842 and 1846, in which the leading spirit was Fazy (q.v.). After 1870 the town was for some years kept in a state of unrest owing to the attempt of the Ultramontanes to revive the Roman Catholic bishopric of Geneva.

Formerly Geneva was surrounded by walls, and consisted of clusters of narrow and ill-drained streets; but since the accession of the radical party to power in 1847 the town has been almost entirely rebuilt in modern style. The ancient ramparts have been removed, streets widened and well paved, new and commodious quays constructed along the shores of the lake and river, and various improvements introduced, chief amongst which is the erection of a breakwater, within which steamboats are received and lie in safety. In its course through the town the Rhone forms two islands, on one of which still exists an antique and picturesque cluster of buildings; on the other, laid out as a public pleasure-ground, is a statue of Rousseau. In the Place des Alpes is a sumptuous monument to Duke Charles XI. of Brunswick, who, dying here in 1873, left 16,500,000 francs to the city. Famous as a theological, literary, and scientific centre, Geneva has given birth to Rousseau; to the physicist De Saussure; to the naturalists Charles Bonnet and Pictet; to Necker, the French minister of finance, and father of Madame de Staël; to the humorist Toepffer; and to the sculptor Pradier. The principal edifices are the Transition cathedral of St Peter, which dates from 1124; the town-hall, within which the members of the Alabama (q.v.) arbitration met in 1872; the academy, founded by Calvin in 1559, with a library of 110,000 volumes, and in 1873 converted into a university (with about 600 students); the magnificent theatre, opened in 1879, which ranks next in size to the Paris Opéra and the Court-theatre of Vienna; the Rath Museum (1824–26); the Fol Museum, with collections of Greek, Roman, and Etruscan antiquities; the Athenæum, devoted to the fine arts; and the museum of natural histor[illegible] geological collection, [illegible] plants, &c. The staple manufactures of the town are watches, musical-boxes, and jewelry. Pop. (1885) 51,537 (with the suburbs Plainpalais and Eaux Vives, 74,453); (1888) 52,457. See works by Cherbuliez (1868), Blavignac (1872), and Roget (1870–83).

The Geneva Convention (1864), signed by twelve delegates from various countries, mainly regards the succour of the wounded in time of war, and forbids cruel methods of warfare (e.g. the use of explosive bullets). The resulting international code was ultimately adopted by all civilised powers except the United States; and a 'Red Cross Society' was established, which became very prominent and helpful during the Franco-German war (1870–71), its flag, with the 'Geneva Cross,' being recognised as neutral. Other international conferences for promoting the same objects were held at Paris (1867) and Berlin (1869). For the Geneva Bible, see BIBLE.

Geneva, a town of New York, at the north end of Seneca Lake, 26 miles W. of Auburn by rail, with flouring-mills and manufactures of engines, boilers, &c. It is the seat of Hobart College (Episcopal, founded in 1824). Pop. (1880) 5878.

Geneva, LAKE OF, or LAKE LEMAN (*Lacus Lemanus*), situated between Switzerland, to which the larger portion belongs, and France. It lies 1218 feet above the level of the sea, and extends for 45 miles from east to west, in the form of a crescent. Its greatest breadth is 9 miles, its area 223 sq. *m.*, and its maximum depth is 1092 feet. This lake at some periods of the year presents a curious phenomenon: the whole mass of water oscillates from side to side of the lake, causing, especially near Geneva, a rise and fall of from two to five feet in the course of about eight or ten minutes (*seiche*). The phenomenon is probably due to differences of barometric pressure on different parts of the surface. The lake abounds in fish. The shore on the side of the Pays de Vaud is a classic spot, celebrated by J. J. Rousseau in his *Nouvelle Héloïse* and by Byron in his *Childe Harold* and in the *Prisoner of Chillon*, while the names of Voltaire and of Madame de Staël are connected with Ferney and Coppet at the Geneva extremity, Gibbon's with Lausanne. The southern French shore rises solemn and stern, with the mountains of Savoy in the background. From the Lake of Geneva, Mont Blanc is visible, and although 60 miles distant, is often reflected in its waters. Mirages are sometimes observed on the lake. The Rhone enters the lake at the upper end, turbid and yellow, and leaves it at the town of Geneva as clear as glass, and of a deep blue tint. The lake receives about twenty unimportant streams along its northern shore.

Geneviève, the patron saint of Paris, was born about 424, in the village of Nanterre, near Paris, and took the veil in her fifteenth year. On the death of her parents she removed to Paris. She acquired an extraordinary reputation for sanctity, which was increased by her confident assurance that Attila and his Huns would not touch Paris, and by an expedition undertaken for the relief of the starving city during the Frankish invasion under Childeric, in which she journeyed from town to town, and returned with twelve ship-loads of provisions. In 460 she built a church over the tomb of St Denis (q.v.), where she was buried at her death in 512. See her Life by Saint-Yves (1845) and Lefeuve (new ed. 1861).

Genghis Khan, originally called Temujin, a celebrated Mongol conqueror, was born in 1162 at Deligun Bulduk on the river Onon (SE. of Lake Baikal), the son of a Mongol chief whose sway extended over great part of the region between the Amur and the Great Wall of China. Being called upon to rule his father's people when only thirteen years of age, Temujin had to struggle hard for several years, first against a confederacy of revolted tribes, then against different confederacies of hostile tribes and neighbouring rivals, whom his uninterrupted successes and rapidly-growing power had made jealous. The most critical period of his career at this juncture occurred during a war with Wang Khan, the powerful chief of the Keraits. Temujin, at first worsted, was compelled to retire to a desert region with only a few warriors; but in the following year (1203) he collected another army, and with it inflicted upon his enemy a crushing and decisive defeat. The Keraits thereupon became subject to Temujin. His ambition awakening with his continued success, the Mongol prince spent the next six years in subjugating the Naimans, a powerful Turkish confederacy who occupied the region between Lake Balkhash and the river Irtish; in conquering Hia or Tangut, a Chinese empire lying between the Desert of Gobi and Chaidam; and in assimilating the results of the voluntary submission of the Turkish Uigurs, from whom the Mongols derived the beginnings of their civilisation, as their alphabet and laws. It was during this period—viz. in 1206, that he adopted the title of Jenghiz or Genghis Khan, equivalent to 'Very Mighty Ruler.'

Bent upon yet more ambitious schemes, he in 1211 refused tribute to the Kin emperor of North China, and invaded and overran his country in several campaigns. About this same time, too, his attention was directed to the west: with comparatively little trouble he defeated the ruler of the Kara-Chitai empire, and annexed (1217) his country, which extended from Lake Balkhash to Tibet. His next undertaking was the most formidable of all, an attack upon the powerful empire of Kharezm, whose confines ran conterminous with the Jaxartes (Sihûn or Sir-Daria), Ferghana, the Indus, Persian Gulf, Kurdistan, Georgia, and the Caspian Sea. Entering this extensive country with three armies in 1218, the Mongol prince and his captains successively took, often by storm, the populous cities of Otrar, Sighnak, Aksi Khojend, Bokhara, and Samarcand, hunted down from one end of his territories to the other Mohammed, the ruler of Kharezm, and the princes of his family, captured Urgenj or Kharezm (now Khiva), devastated with most horrible cruelties and barbarities the beautiful and prosperous province of Khorasan and its cities (Nessa, Merv, Nishapur, and Herat), chased Jelal-ud-Din, son and heir of Mohammed, across the Indus into India, and finally returned home in 1225 by the way they had come. Two of Genghis' lieutenants, Chépé and Subutai, who had so relentlessly and pertinaciously hunted down Mohammed, passed on from the southern shore of the Caspian northwards through Azerbijan and Georgia, then, turning to the west, they traversed southern Russia and penetrated to the Crimea, everywhere routing and slaying, and finally returned by way of Great Bulgaria and the Volga, beyond the northern end of the Caspian—a marvellous military raid. Meanwhile in the far east Mukuli, one of the most capable amongst the group of the great conqueror's clever generals, had completed the conquest of all northern China (1217–23) except Honan.

Genghis did not long stay quietly at home. After but a few months' rest he again took to the saddle, to go and chastise the king of Hia or Tangut, who had refused him obedience. But this was his last expedition, for, after thoroughly subduing the country, Genghis died of sickness, on 18th August 1227, amongst the northern offshoots of the Kuen-Lun called the Mountains of Liupan. The rapidity and magnitude of his conquests seem to have been as much due to the admirable discipline and organisation of his armies as to the methods in which he conducted his campaigns. His troops were all horsemen, hardy, abstemious, inured to fatigue, indifferent to weather, accus-

tomed to go days and nights in the saddle without resting. Thus the Mongol armies could move with extreme celerity, and needed little provisioning. They never left either enemy or strong town behind their backs to threaten their communications: all the former were ruthlessly slain or massacred, all the latter completely razed to the ground. The hard labour necessary in besieging the fortified cities was done by the peasantry of the country in which they were situated, and in the battles the same wretched people were frequently placed by the Mongols in the forefront of the fight to bear the brunt of their enemies' onset. Genghis was, however, something more than a warrior and conqueror; he was also a skilful administrator and ruler: he not only conquered empires stretching from the Black Sea to the Pacific, but he organised them into states which endured beyond the short span that usually measures the life of Asiatic sovereignties.

See Howorth, *History of the Mongols*, part 1 (1876); R. K. Douglas, *Life of Jenghiz Khan* (1877); and compare Erdmann, *Temudschin, der Unerschütterliche* (1862), and D'Ohsson, *Histoire des Mongoles* (1852).

Genii, among the ancient Romans, were protecting spirits, who were supposed to accompany every created thing from its origin to its final decay, like a second spiritual self. They belonged not only to men, but to all things animate and inanimate, and more especially to places, and were regarded as effluences of the Divinity, and worshipped with divine honours. Not only had every individual his genius, but likewise the whole people. The statue of the national genius was placed in the vicinity of the Roman forum, and is often seen on the coins of Hadrian and Trajan. The genius of an individual was represented by the Romans as a figure in a toga, having the head veiled, and the cornucopia or patera in the hands; while local genii appear under the figure of serpents eating fruit set before them. Quite different are the genii whose Arabic name, *Djinn* or *Jinn*, was translated by the Latin term *genius*, for want of a better word, or from the casual similarity of the sounds. See DEMONOLOGY, and FAMILIAR.

Genipap, *Genipa americana* (Cinchonaceæ), a large tree of the West Indies and warm parts of South America, with excellent fruit. The pearl-gray timber is occasionally used by joiners.

Genista (Celtic *gen*, 'a shrub'), a leguminous genus already mentioned under BROOM (see also GREENWEED). *G. anglica*, a small, much branched, very spiny shrub of poor soils, is called Petty Whin and Needle Furze in England. The *Genista* of Virgil and other Roman classics is supposed to be *G. hispanica*, of southern Europe, with branched stiff spines. The name Plantagenet is from *Planta Genista;* but what plant was intended, and whether the common broom, furze, or a species of Genista is not so certain. See PLANTAGENET.

Genitive. See GRAMMAR.

Genlis, STÉPHANIE FÉLICITÉ DUCREST DE ST AUBIN, COMTESSE DE, was born at Champcéri, near Autun, in Burgundy, 25th January 1746. At the age of sixteen she was married to the Comte de Genlis, and in 1770 was made lady-in-waiting to the Duchesse de Chartres. In 1782 the Duc de Chartres, afterwards known as Égalité, appointed her 'governor' of his children, including Louis-Philippe. Madame de Genlis wrote a variety of works for her pupils, among others *Théâtre d'Éducation* (1779-80), a collection of short comedies; *Annales de la Vertu* (1781); *Adèle et Théodore, ou Lettres sur l'Éducation* (1782); and *Les Veillées du Château* (1784). On the breaking out of the Revolution Madame de Genlis took the liberal side, but was ultimately compelled to seek refuge (1793) in Switzerland and Germany. When Bonaparte became consul she returned (1799) to Paris, and received from him a pension. She died at Paris, 31st December 1830. Madame de Genlis's writings amount to about ninety volumes. Amongst them may be mentioned the romance *Mdlle. de Clermont* (1802), *Mémoires Inédits sur le XVIII. Siècle et la Révolution Française* (10 vols. 1825), and *Dîners du Baron d'Holbach.* The last contains a great deal of curious but malicious information concerning the freethinkers of the 18th century. See Bonhomme's *Mme. de Genlis* (Paris, 1885).

Gennesaret, SEA OF. See GALILEE.

Genoa (Ital. *Genova*, Fr. *Gênes*, anciently *Genua*), a city of Italy, situated on the Mediterranean gulf of the same name, at the foot of the Apennines, is the capital of a province and the most important seaport. By rail it is 801 miles SE. of Paris, 171 NE. of Marseilles, and 93 SSW. of Milan. Pop. of the town (1881) 138,081; of the commune, 179,515; pop. of the province of Genoa (area, 1572 sq. m.) 760,122.

The slopes of the hills behind the city down to the shore are covered with buildings, terraced gardens, and groves of orange and pomegranate trees; while the bleak summits of the loftier ranges rising still farther back are capped with a line of strong forts, batteries, and outworks. The fine harbour, semicircular in shape, with a diameter of rather less than a mile, is protected seawards from the south and south-east winds by two piers. In front of this inner harbour another one has been made by the construction of two outer moles. Besides this, the quays of the inner harbour have been greatly improved, and in 1889 graving-docks and other works were completed. On the north side of the port is a naval harbour and a marine arsenal; and on the east side the warehouses of the former (until 1867) free port. Genoa is the commercial outlet for a wide extent of country, of which the chief exports are rice, wine, olive-oil, silk goods, coral, paper, macaroni, and marble. The imports are principally raw cotton, wheat, sugar, coal, hides, coffee, raw wool, fish, petroleum, iron, machinery, and cotton and woollen textiles. The annual exports of Genoa are valued at nearly £4,000,000, while the imports are returned at more than £15,000,000. About 5800 vessels, of 2,970,000 tons burden, enter annually, and about 5750 of 2,979,000 tons clear, three-fourths of the vessels, with nearly one-half of the tonnage in each class, being Italian. The principal industrial establishments of the city embrace iron-works, cotton and cloth mills, macaroni-works, tanneries, sugar-refineries, and vesta match, filigree, and paper factories. From 70,000 to 100,000 emigrants sail every year from Genoa for South America; in 1888 the number rose to 181,437.

While strikingly grand as viewed from the sea, and so far worthy of being entitled *Genova la Superba*, Genoa is in reality built awkwardly on irregular rising ground, and consists of a labyrinth of narrow and intricate lanes, accessible only to foot-passengers, or to the pack-mules by the use of which a large portion of the internal goods traffic is conducted. These thoroughfares, into which the light of day imperfectly penetrates, are lined with tall buildings, some of them of marble and of handsome architecture, but now in many cases transformed into hotels or business establishments. Of the palaces the most famous are the ducal palace formerly inhabited by the doges, now appropriated to the meetings of the senate; and the Doria, presented in 1529 to the great Genoese citizen Andrea Doria, whose residence it was during his presidency of the republic. The palaces Brignole-Sale, Reale,

Durazzo-Pallavicini, Spinola, Balbi-Senarega, and others possess great interest on account of their historical fame and architectural beauty. Many of them contain galleries of paintings; the Brignole-Sale has works by Van Dyck, Rubens, Albrecht Dürer, Paolo Veronese, Guercino, &c. Foremost amongst the churches stands the cathedral of St Lorenzo, a grand old pile in the Italian Gothic style, built in the 12th century and frequently restored. In the church of St Ambrogio (1589) are pictures by Guido Reni and Rubens, and in that of St Stefano an altar-piece by Giulio Romano; the interior of L'Annunziata is splendid with fine marbles and rich gilding. The marble municipal palace, built in the Late Renaissance style, with a magnificent vestibule, courtyard, and galleries, and the palace of the Dogana must also be mentioned. The university (790 students in 1886), originally built in 1623, reorganised in 1812, has a library of 116,000 volumes. Genoa is well supplied with technical schools and institutions for higher education. The great hospital, the asylum for the poor (provision for 2200 persons), the deaf and dumb institution, and the hospital for the insane are amongst the finest institutions of their kind in Italy. There are numerous excellent philanthropic foundations, as the Fieschi, an asylum for female orphans. Furthermore, we must mention the public library, containing 50,000 volumes; the Academy of Fine Arts, founded (1751) by the Doria family; the Carlo Felice Theatre, one of the finest in Italy; and the Verdi Institute of Music.

The Genoese are a shrewd, active, laborious race, and possess all the qualities of a commercial and maritime community. They make skilful and hardy seamen, and are still remarkable for the spirit of enterprise and freedom which so strongly characterised the period of the republic. To Columbus, Genoa's most famous son, there is a fine monument (1862) by Lanzio.

History.—Genoa, anciently the capital of Liguria, is first mentioned as a place of considerable importance in the second Punic war. Having been destroyed by Mago, brother of Hannibal, in 205, it was rebuilt three years later by the Roman prætor Sp. Lucretius. On the dismemberment of the Latin empire Genoa fell successively under the sway of the Lombards, the Franks, and the Germans; but amid all these vicissitudes it preserved, in a singular degree, both privileges and prosperity. At length it succeeded in establishing its independence as a republic. Even thus early commerce was the source of its power. The frequent incursions of the Saracens, by whom Genoa was sacked and pillaged in 936, led the Genoese to form an alliance with Pisa with the object of driving the aggressors from Corsica and Sardinia, their strongholds in the Mediterranean. This being effected (1017–21), the Genoese obtained, by papal arbitration, the grant of Corsica, while Sardinia was assigned to the Pisans, a distribution which sowed the seeds of future discord between the two states. At the close of the 11th century Genoa commanded large land and naval forces, and ranked as a powerful maritime state, governed by annual magistrates named consuls. The Genoese vigorously seconded the Crusades, and in return for their effective co-operation obtained several important maritime possessions and commercial privileges in the Holy Land (1109). The chief events of the three following centuries were the capture of Minorca (1146), Almeria (1147), and Tortosa (1148) from the Moors; the wars with Pisa and Venice; and the civil dissensions by which Genoa, in common with all Italy, became distracted by the Guelph and Ghibelline factions. In 1284, at the naval battle at Meloria the Pisan Republic sustained such destructive losses that her maritime influence and public spirit never revived. The wars with Venice originated about 1244 in mutual jealousies respecting the commercial supremacy in the Levant, and continued, with various vicissitudes, till the end of the following century, when the Genoese, after the blockade of Chioggia (1379), were compelled to submit to disadvantageous terms by the peace of Turin (1381).

Co-existent with this troublous external history, civil dissensions exhausted and demoralised the state, and occasioned an infinity of changes in the primitive form of government. In 1217 the consuls were superseded by a magistrate termed *podesta*, generally chosen from a foreign state, natives of Genoa being declared ineligible. During the next hundred years civil feuds raged inveterately, not alone between the Guelph and Ghibelline factions, but also between the patricians and the plebeians. Various other modifications of the government preceded the election of the first Genoese doge in 1339. This supreme magisterial office, from which all nobles were excluded, continued in force for two centuries, its tenure being for life. But even then matters did not improve much. Finally, in 1396, the citizens, in despair, invoked the protection of the French king, Charles VI., and, after alternating between France and Milan, at last submitted to the rule of the lords of Milan (1464). In 1407 was founded the bank of St George, which eventually became a very powerful association, not only financially but also politically. From the invasion of Milan by Louis XII. in 1499 Genoa remained subject to the French until, in 1528, the genius and resolution of Andrea Doria (q.v.) freed his country from foreign invaders, and restored to her her republican institutions. The Fieschi conspiracy, which had for its object the overthrow of Doria and the destruction of the French party amongst the nobles, was suppressed in 1547. The 17th century is marked by two wars against the Duke of Savoy (1631 and 1672) and the bombardment of the town by Louis XIV. (1684). The last important exploit of the Genoese was the expulsion in 1746 of the Austrians after an occupation of three months. In 1768 Genoa ceded to France the island of Corsica; and when Bonaparte invaded Italy he conferred (1797) on Genoa the name of the *Ligurian Republic*, which in 1802 was abolished, Genoa becoming the chief town of a department of France. In 1814 Lord Bentinck stormed the forts and captured the city, whereupon he restored the constitution which had existed previous to 1797. In 1815, by a decree of the Congress of Vienna, the state of Genoa was made a province of Piedmont. Following the fortunes of that state, it was finally incorporated in the kingdom of Italy. The opening of the St Gothard railway has greatly increased the trade of Genoa with Germany. See J. T. Bent, *Genoa: How the Republic rose and fell* (1880).

Genoa, GULF OF, a large indentation in the northern shore of the Mediterranean, north of Corsica, has between the towns of Oneglia on the west and Spezia on the east a width of nearly 90 miles, with a depth of about 30 miles.

Genre-painting. *Genre* (French, from the Latin *genus*, 'a kind') is a term in art which was originally used to indicate simply any class or *kind* of painting, and was always accompanied by a distinctive adjective or epithet, as *genre historique*, 'historical painting,' *genre du paysage*, 'landscape-painting.' The phrase *genre* or *genre-painting*, however, has now come to be applied to scenes from familiar or rustic life, to all figure-pictures which, from the homeliness of their subjects, do not attain to the dignity of 'historical' art. *Genre*-painting, in its most typical development,

may be studied in the interiors and rustic subjects of such Dutch figure-painters as Teniers, Ostade, De Hooch, Jan Steen, and Terburg. In France the most eminent *genre*-painters were Watteau, Lancret, Greuze, and Chardin; while in England the works of Hogarth, Wilkie, Mulready, and the elder Leslie may be mentioned as belonging to this class.

Gens. See FAMILY and TRIBE.

Genseric (more correctly Gaiseric), king of the Vandals, was an illegitimate son of Godigiselus, who led the Vandals in their invasion of Gaul, and perished with 20,000 of his followers in a defeat by the Franks (407 A.D.), who were only prevented from completely destroying the Vandals by the timely intervention of the Alans. In the year 409 the Vandals, with their friendly allies the Suevi and the Alans, poured over the Pyrenees into Spain, and shared its territory between them. The Vandals were divided into two branches, the Asdingi, who settled in Galicia, and the Silingi, who occupied Bætica in the south. The latter, after suffering crushing defeats from the Romans, joined the former under their king Gunderic, son of Godigiselus, whose nation soon became the most powerful in the Peninsula. Gunderic died in 427, and was succeeded by Genseric. Invited to the invasion of Africa by Bonifacius, Count of Africa, who had been goaded on to rebellion through the machinations of his rival Aetius, the conqueror of Attila, Genseric first crushed the Suevi, and, after numbering his united Vandals and Alans on the Andalusian shore, crossed over to Numidia in 428. Only when it was too late did Bonifacius repent his treacherous designs and attempt in vain to drive back the Vandals. After a thirteen months' siege, in the course of which the great St Augustine died, the city of Hippo Regius fell (430), and was given over to all the fury of wanton and brutal outrage. With such ferocity did the Vandals lay waste and destroy churches, fields, and cities as to leave their name after fourteen centuries a synonym for destructive barbarism. All Africa west of Carthage quickly fell into the hands of Genseric, who seized that city itself in 439, and made it the capital of his new dominions. He dated his reign, which lasted thirty-seven years, from this conquest.

With a capacity for adapting himself to new conditions which shows his genius, he quickly built up a formidable maritime power, and his fleets scoured the Mediterranean and carried the terror of his name to Sicily, the southern coasts of Italy, Illyricum, and the Peloponnesus. He next portioned out the soil of the province of Carthage among his soldiers, and settled the succession. A bigoted Arian in his theology, he persecuted the orthodox Catholics in his dominions with ferocious rapacity and cruelty. The murder of the great Aetius (454), and of his murderer and master Valentinian III., opened up a new field for his ambition. Eudoxia, the widow of Valentinian, eager for revenge upon her husband's murderer Maximus, invited Genseric to Rome. The Vandal fleet reached the mouth of the Tiber in June 455. The wretched Maximus had already fallen, and the city could offer no resistance; all Pope Leo's entreaties did not save it fourteen days of devastating plunder. On leaving the city Genseric carried with him the empress and her two daughters, one of whom became the wife of his son Hunneric. The empire twice endeavoured to avenge the indignities it had suffered, but without success. First the Western emperor, Majorian, fitted out a fleet against the Vandals in 457, which was destroyed by Genseric in the bay of Carthagena; next, the Eastern emperor, Leo, sent an expedition under the command of Heraclius and others in 468, which was also destroyed off the city of Bona. Genseric died in 477, in the possession of all his conquests, leaving behind him the reputation of being the greatest of the Vandal kings. His appearance was not imposing: Jordanes describes him as of low stature, and lame on account of a fall from his horse, deep in his designs, taciturn, averse to pleasure, subject to transports of fury, greedy of conquest, and cunning in sowing the seeds of discord among nations, and exciting them against each other. He was ruthless in his cruelty, and seems to have found impulse in the fierce and fanatical bigotry of his religion. Once, when leaving the harbour of Carthage on an expedition, the pilot asked him whither he was going. 'Against all who have incurred the wrath of God,' said the conqueror.

Gentian (*Gentiana*—so called after the Illyrian king Gentius, who is said by Pliny to have introduced *G. lutea* into medicine), a genus of Gentianaceæ. There are more than 100 species, natives of north temperate regions, very often growing in high mountain pastures and meadows, which they cover with their beautiful blue or yellow flowers. The roots of the Common Gentian or Yellow Gentian (*G. lutea*) are collected by the peasants of the Alps (along with the less valuable roots of *G. pannonica*, *purpurea*, and *punctata*) to furnish the gentian root (*radix gentianæ*) of pharmacy, which is largely employed as an excellent bitter and stomachic. The medicinal properties are essentially due to the presence of a bitter glycoside (*gentiopicrin*); pectin (see FRUIT) and also sugar are present in quantity; hence the peasants of the Alps prepare alcoholic bitters—their *Enziangeist*—by the fermentation of the fresh roots. *G. Catesbæi* is used as gentian root in North America, and *G. Kurroo* in the Himalayas.

The florist recognises two main groups of these beautiful hardy plants, the first strong and easily grown in borders, of which the Willow Gentian (*G. asclepiadea*) and *G. lutea* are specially common. The former can also be grown with good effect under trees and among grass. The dwarf kinds require more careful treatment, with the exception of the Common Gentianella (*G. acaulis*), which readily forms edgings and carpets. The name Gentianella is sometimes also applied to the allied *Cicendia filiformis*, a small, slender, and graceful plant with yellow flowers. *G. verna* (Vernal Gentian) can be grown well in deep sandy loam, with abundant moisture and sunshine. Bavarian Gentian (*G. bavarica*) and Crested Gentian (*G. septemfida*) of the Caucasus require more moisture. Other species can be cultivated with care. Of North American species *G. crinita* is specially celebrated for the beauty of its flowers; the genus in fact may fairly be allowed the very first place among the floral glories alike of Alpine regions, in which they range up to the snow-level, and of the alpine garden. Several species of Gentian are popularly called *Baldmoney*. See ALPINE PLANTS.

Crested Gentian (*Gentiana septemfida*).

Gentianaceæ form an order of corollifloral dicotyledons. The 500 species are almost exclusively herbaceous, and are usually natives of temperate and cold latitudes and altitudes. Many have

flowers of great beauty, and a general astringency pervades the order, whence many are of past or present medicinal repute. See CHIRATA, BUCKBEAN, and CENTAURY.

Gentile (Lat. *gentilis*, from *gens*, 'a nation'), in Scripture, a member of a non-Jewish nation, an alien, an unbeliever, a non-Christian. The Heb. *goïm*, pl. of *goï*, 'nation,' is used both of foreigners in general and foreigners as enemies, as heathens; so in the New Testament the Greek *ethnē*, 'nations,' and *Hellēnes*, 'Greeks,' though sometimes meaning simply foreigners, non-Jews, usually had the invidious sense of unbeliever, heathen. Compare the Greek use of Barbarian (q.v.).

Gentile da Fabriano. See FABRIANO.

Gentilly, a southern suburb of Paris, on the circular railway, at the foot of the Bicêtre hill. It has a number of villas, tanneries, and manufactures of biscuits, vinegar, mustard, and soap. Pop. (1886) 14,278, many of them employed in the neighbouring quarries and in washing.

Gentleman, in its original and strict sense, a person of noble descent. The first part of the word comes from the Latin *gentilis*, which signifies belonging to a *gens* or family. The terms gentleman and nobleman were formerly identical in meaning; but the popular signification of each has become gradually modified, that of the former having widened, of the latter having become more restricted. The continental *noble* (Fr.) or *adel* (Ger.) still retains the original sense of our gentleman. The broadly-marked distinction between the nobleman or gentleman and the rest of the community is one of the most prominent features of medieval life, and the source from which the less abrupt gradations of rank in modern society have been developed. The gentry of England had formerly many privileges recognised by law. If a churl or peasant defamed the honour of a gentleman, the latter had his remedy in law, but if one gentleman defamed another, the combat was allowed. In equal crimes a gentleman was punishable with less severity than a churl, unless the crime were heresy, treason, or excessive contumacy. A gentleman condemned to death was beheaded and not hanged, and his examination was taken without torture. In giving evidence the testimony of a gentleman outweighed that of a churl. A churl might not challenge a gentleman to combat, *quia conditiones impares*. After the introduction of heraldry the right to armorial ensigns or *insignia gentilitia* became (as the *jus imaginum* had been among the Romans) the test of gentility or nobility. Gentility was of course inherited; but it was also within the prerogative of a sovereign prince to ennoble or make a gentleman of a person of a lower grade whom he thought worthy of the distinction, and whose descendants accordingly became gentlemen. We have examples in England of the direct exercise of this prerogative by the sovereign as late as the reign of Henry VI., the patent of gentility or nobility being accompanied with no title of honour, but merely with a coat of arms, the grant containing the words '*nobilitamus nobilemque facimus et creamus . . . et in signum hujusmodi nobilitatis arma et armorum insignia damus et concedimus.*' Letters of nobility of a similar description are granted by the emperor in Germany and Austria to the present day, conferring no title, but only the status of *adel* (nobleman or gentleman) indicated by the prefix *von* to the surname. A gentleman of ancestry was (or is) something beyond a gentleman of blood and coat-armour: he must be able to show purity of blood for five generations—i.e. that his ancestors on every side for four generations back—viz. his eight great-great-grandfathers and eight great-great-grandmothers—were all entitled to coat-armour. This purity of blood is still insisted on for certain offices in Germany and Austria. In England the concession of *insignia gentilitia* (or of creating a gentleman) has long been deputed to the kings of arms, the prerogative of the sovereign in the matter of rank being directly exercised only in creating peers, baronets, or knights. In our own day, while the stricter meaning of the word is retained in the expression 'gentleman by birth,' the less abrupt gradation of ranks and the courtesy of society have caused the term gentleman to be applied in a somewhat loose sense to any one whose education, profession, or perhaps whose income, raises him above ordinary trade or menial service, or to a man of polite and refined manners and ideas. See ESQUIRE, NOBILITY.

Gentleman-commoner. See OXFORD (*University*).

Gentlemen-at-arms (formerly called the GENTLEMEN-PENSIONERS), the bodyguard of the British sovereign, and, with the exception of the yeomen of the guard, the oldest corps in the British service. It was instituted in 1509 by Henry VIII., and now consists of 1 captain, who receives £1200 a year; 1 lieutenant, £500; 1 standard-bearer, £310; 1 clerk of the cheque, £120; and 40 gentlemen, each with £70 a year. The pay is issued from the privy purse. Until 1861 the commissions were purchasable, as in other regiments; but by a royal command of that year this system was abolished, and commissions as gentlemen-at-arms have since only been given to military officers of service and distinction. The attendance of the gentlemen-at-arms is only required at drawing-rooms, levées, coronations, and similar important state ceremonies. The appointment, which is in the sole gift of the crown, on the recommendation of the commander-in-chief, can be held in conjunction with half-pay or retired full-pay, but not simultaneously with any appointment which might involve absence at the time of the officer's services being required by the sovereign.

Gentoo' (Portuguese *Gentio*, 'Gentile'), the term applied by old English writers to the Hindus, or natives of India; and in especial to the *Gentoo* laws, a code compiled by Sir William Jones.

Gentz, FRIEDRICH VON, politician and writer, was born at Breslau, 2d May 1764, and, shortly after entering the Prussian civil service, published his first work, a translation of Burke's *Essay on the French Revolution* (1793). In 1786 he entered the public service of Prussia, but in 1802 exchanged into that of Austria, having a short time previously paid a visit to England, where he became acquainted with Mackintosh, Grenville, Pitt, and other public men. Throughout the struggle against Napoleon he distinguished himself by writings full of burning hatred to the French emperor. At the Congress of Vienna in 1814 Gentz was appointed first secretary, and he held the same post in nearly all the subsequent conferences down to that of Verona (1822). From 1810 onwards he laboured as an adherent of Metternich. His writings, which are of a miscellaneous character, are distinguished for the elegance and correctness of their style. But his pen was always on sale to the highest bidder; and he drew the supplies by which he met his lavish private expenditure from more than one government outside Austria. He died 9th June 1832. See his Life by K. Mendelssohn-Bartholdy (1867).

Genuflexion, the act of bending the knees in worship or adoration. It is of frequent occurrence in the ritual of the Catholic Church: Catholics genuflect passing before the tabernacle where the

sacrament is reserved; the priests genuflect repeatedly during mass, &c. See KNEELING.

Genus (Lat., 'a kind'), in Natural History, a group of Species (q.v.) closely connected by common characters or natural affinity. In all branches of zoology and botany the name of the genus forms the first part of the scientific name of each organism, and is followed by a second word—either an adjective or a substantive—which distinguishes the particular species. This binomial nomenclature was introduced by Linnæus, and has been of great advantage, making names serve, in some measure, for the indication of affinities.

Some genera are more satisfactory than others, the question turning on the nature of the component Species (q.v.). A genus may contain a single species—e.g. the genus Ornithorhynchus; or it may include several hundreds, and in such cases especially it is often split up into sub-genera. Groups of related genera form a *family*, groups of allied families form an *order*, and above orders are *class* and *phylum*. But, again, we may have an order with only a couple of living representatives, as in Proboscidea (elephants), or with only one, as in the Hyracoidea (conies). The real difficulties concern species, and will be discussed under that title. See also GENERALISATION.

Genzano, a town of Italy, on the Via Appia, 16 miles SE. of Rome, lies near the lake of Nemi, and contains the Cesarini palace. It is noted for its annual flower festival (*Infiorata di Genzano*), held on the eighth day after Corpus Christi, which attracts many visitors. Pop. 5291.

Geocentric means having the earth for centre. Thus, the moon's motions are geocentric; also, though no other of the heavenly bodies revolves round the earth, their motions are spoken of as geocentric when referred to, or considered as they appear from, the earth. The geocentric latitude of a planet is the inclination to the plane of the ecliptic of a line connecting it and the earth; the geocentric longitude being the distance measured on the ecliptic from the first point of Aries to the point in the ecliptic to which the planet as seen from the earth is referred.

Ge'odes (Gr., 'earthy') are rounded hollow concretions, or indurated nodules, either empty or containing a more or less solid and free nucleus, and having the cavity frequently lined with crystals. They are sometimes called 'potato stones,' on account of their size and shape. They were the *aëtites* ('eagle-stones') of the Greeks, who asserted they were found only in eagles' nests. The eagles could not breed without their aid, and the aëtites were supposed to be beneficial to women in labour.

Geo'desy, the science of measuring or surveying extensive portions of the earth's surface by means of Triangulation (q.v.). The objects of the survey are generally to determine the contour and dimensions of the earth, and in a secondary degree to acquire materials and measurements for accurate maps.

Geoffrey of Monmouth, a famous Latin chronicler, who was Archdeacon of Monmouth, was consecrated Bishop of St Asaph in 1152, and died about 1154. His chief work, the *Chronicon sive Historia Britonum*, was dedicated to Robert, Earl of Gloucester, and must therefore have been composed previous to 1147, the date of the latter's death. It need hardly be said that it possesses little value as history, but there is perhaps but one other book that has exercised, directly or indirectly, so profound an influence upon English literature. Its author professes to have merely translated his work from a chronicle entitled *Brut y Brenhined*, a History of the Kings of Britain, found in Brittany, and communicated to him by Walter Calenius, Archdeacon of Oxford; but the work is really nothing more than a masterpiece of the creative imagination working freely on materials found in Gildas, Nennius, and such chroniclers, as well as early legends now difficult to trace. In the dedicatory epistle Geoffrey describes his original as 'a very ancient book in the British tongue, which in a continued regular story and elegant style related the actions of them all, from Brutus, the first king of the Britains, down to Cadwallader the son of Cadwallo.' An abridgment of the *Historia* was made by Alfred of Beverley as early as 1150, and it was translated into Norman-French by Geoffrey Gaimar in 1154, and by Wace (*Li Romans de Brut*) with new matter in 1180. Layamon's *Brut* (early in 13th century) was a semi-Saxon paraphrase of Wace, and Robert of Gloucester's *Chronicle* was a fresh rhymed paraphrase of the same, which being in the native tongue helped to make the legends invented by Geoffrey widely known. The convincing circumstantiality of the story, and the ingenuity of its etymological connection of existing place-names with eponymous heroes, as well as its irresistible identifications and dovetailings into British history of details of scriptural and of Roman story were sufficient for an uncritical age; and henceforward the Trojan origin of the British people became a point of patriotism and an established historical fact. The stories of King Lear and of Cymbeline, the prophecies of Merlin, and the legend of the famous Arthur in the form in which we know it, owe their origin to the rich imagination of Geoffrey of Monmouth, who still influences us enormously in our Malory, Drayton, Shakespeare, Spenser, Milton, and Tennyson. Chaucer gives 'Englyssh Gaunfride' a niche in his *House of Fame* as being 'besye for to bere up Troye.' Yet the book, even in its own day, did not altogether escape the censure of more severe historians. A Yorkshire monk, William of Newburgh, denounces Geoffrey with honest indignation as having 'lied saucily and shamelessly.' 'A certain writer has come up in our times to wipe out the blots on the Britons, weaving together ridi[illegible] about them, and raising them with [illegible] above the virtue of the Mace[illegible] This man is named Geoffrey, and has the by-name of Arturus, because he cloaked with the honest name of history, coloured in Latin phrase, the fables about Arthur, taken from the old tales of the Bretons, with increase of his own.' Giraldus Cambrensis, writing within fifty years after, distinctly speaks of the book as fabulous, and gives us a somewhat singular but perfectly conclusive proof of this by relating the story of a Welshman at Caerleon named Melerius, who, 'having always an extraordinary familiarity with unclean spirits, by seeing them, knowing them, talking with them, and calling each by his proper name, was enabled through their assistance to foretell future events. . . . He knew when any one spoke falsely in his presence, for he saw the devil as it were leaping and exulting on the tongue of the liar. . . . If the evil spirits oppressed him too much, the Gospel of St John was placed on his bosom, when, like birds, they immediately vanished; but when that book was removed, and the History of the Britons by Geoffrey Arthur was substituted in its place, they immediately reappeared in greater numbers, and remained a longer time than usual on his body and on the book.'

Geoffrey's *Chronicle* was printed as early as 1508. An English translation by Aaron Thompson appeared in 1718, and was issued in Bohn's 'Antiquarian Library' in 1848.

Geoffrin, MARIE THÉRÈSE, born at Paris, 2d June 1699, was the daughter of a valet de chambre named Rodet, a native of Dauphiné; and in her

fifteenth year was married to a very rich citizen in the Faubourg St Antoine, who died not long after, leaving her an immense fortune. Madame Geoffrin, though herself but imperfectly educated, had a genuine love of learning and art, and her house soon became a rendezvous of the men of letters and artists of Paris. Every illustrious foreigner was welcomed to her circle, but her dearest friends were the *philosophes*, and upon them in their necessities she showered her money with equal delicacy and liberality. Among her friends she numbered Montesquieu, Marmontel, Morellet, Thomas, and Stanislaus Poniatowski, afterwards king of Poland. The last is said to have announced to her his elevation to the throne in the words: 'Maman, votre fils est roi.' In 1766 he prevailed on her to visit Warsaw, where she was received with the greatest distinction, and subsequently in Vienna she met the same reception from the Empress Maria Theresa and her son, Joseph II. Madame Geoffrin died in October 1777, leaving legacies to most of her friends. Towards the publication of the *Encyclopédie* she contributed, according to the calculations of her daughter, who was no friend to her mother's pet philosophers, more than 100,000 francs. The panegyrics of D'Alembert, Thomas, and Morellet are to be found in the *Éloges de Madame Geoffrin* (1812). Morellet likewise published her treatise *Sur la Conversation*, and her *Lettres*.

Geoffroy Saint-Hilaire, ÉTIENNE, French zoologist and biologist, was born at Étampes (Seine-et-Oise), 15th April 1772. He was at first destined for the clerical profession, but shortly after beginning his studies at Paris he came into contact with Brisson, who awakened in him a taste for the natural sciences. He subsequently became a pupil of Haüy, Fourcroy, and Daubenton. In June 1793 he was nominated professor of Vertebrate Zoology in the newly-instituted Museum of Natural History at Paris. That same year he commenced the foundation of the celebrated zoological collection at the Jardin des Plantes. The year 1795 is marked by his introduction to his subsequent friend and scientific opponent, Georges Cuvier. In 1798 Geoffroy formed one of the scientific commission that accompanied Bonaparte to Egypt, and he remained in that country until the surrender of Alexandria in 1801. He succeeded in bringing to France valuable collections of natural history specimens; his labours in connection with this expedition led to his election, in 1807, into the Academy of Sciences. In 1808 he was sent by Napoleon to Portugal, to obtain from the collections in that kingdom all the specimens which were wanting in those of France. On his return he was appointed (1809) to the professorship of Zoology in the Faculty of Sciences at Paris. All his important works were published between this date and his death, which took place on 19th June 1844. Throughout almost all his writings we find him endeavouring to establish one great proposition—viz. the unity of plan in organic structure (see EVOLUTION, Vol. IV. p. 481). This was the point on which he and Cuvier mainly differed, Cuvier being a firm believer in the invariability of species, and grouping the Linnean genera under the four divisions of vertebrates, molluscs, articulates, and radiates. Geoffroy also raised teratology or the study of monstrosities and anatomical malformations to the rank of a science, principally in his *Philosophie Anatomique* (2 vols. 1818–20). In addition to this he wrote *Sur l'Unité de Compos* … *l'Histoire Naturelle des* … F. Cuvier; *Philosophi* … *Progressives d'un Natu* … erous papers, mostly on comparative anatomy, scattered through magazines. See Life (1847) by his son Isidore, which contains a bibliography of his works; also the Appendix to vol. i. of De Quatrefages's *Rambles of a Naturalist* (1863).

His son ISIDORE, biologist and naturalist, was born in Paris, 16th December 1805. Educated in natural history by his father, he became assistant-naturalist at the zoological museum in 1824. He too made a special study of teratology, publishing in 1832–37 *Histoire des Anomalies de l'Organisation chez l'Homme et les Animaux*. As zoological superintendent he was led to study the domestication of foreign animals in France; and the results of his investigations appeared in *Domestication et Naturalisation des Animaux Utiles* (1854); in the same year he founded the Acclimatisation Society of Paris. In 1838 he proceeded to Bordeaux to organise a faculty of sciences. On the retirement of his father three years later, Isidore was appointed to the vacant chair, which in 1850 he resigned for that of Zoology at the Faculty of Sciences. In 1852 he published the first volume of a great work entitled *Histoire Générale des Règnes Organiques*, in which he intended to develop the doctrines of his father, but he died at Paris, 10th November 1861, before completing the third volume. He was a strong advocate of the use of horse-flesh as human food, and championed his views in *Lettres sur les Substances Alimentaires, et particulièrement sur la Viande de Cheval* (1856).

Geognosy (Gr. *gē*, 'the earth;' *gnōsis*, 'knowledge'), the study of the materials of the earth's substance, is a term now superseded by *Petrography*. See GEOLOGY.

Geographical Distribution. There is no branch of scientific inquiry the interest and importance of which have grown more rapidly in recent years than that which forms the subject of the present article. In chief measure this is due to the totally different complexion given to the inquiry by the publication of the Darwinian views of the Origin of Species. As long as it was held that each species must have been created, as a general rule, within the geographical area which it now occupies, the most curious facts of distribution could be regarded only with 'sterile wonder.' But when the idea came to be entertained that allied species have had a common origin, it was obviously implied that they or their ancestors must have had a common birthplace; and consequently, when we find members of a group severed from their nearest kindred, we feel bound to inquire how this came about. Thus, when it is observed that all the West Indian mammals, with one exception, are allied to those of America, we at once infer that the ancestors of these animals must have been derived from that continent, and we have to determine how the passage was made from the mainland to the islands; and the problem becomes much more difficult when we find that the single exception referred to 'belongs to an order, Insectivora, entirely absent from South America, and to a family, Centetidæ, all the other species of which inhabit Madagascar only' (Wallace, *Geographical Distribution of Animals*). Similarly, we have to explain how the tapirs are confined to the Malayan region and South America; the Camelidæ to the deserts of Asia and the Andes; marsupials to the Australian region and America; how the mammals and birds of North America resemble those of Europe more than those of South America; how the flora of Japan presents greater affinities to that of the Atlantic than to that of the Pacific States of North America; and so on.

The considerations that must be taken into account in dealing with the problems of distribution are far too numerous and complex to be gone into fully within the limits of an encyclopædia article, and all that can be done under this head is

to indicate the nature of the more important facts affecting the solution of these problems. One of the principal means of throwing light on this subject must obviously be to consider by what means animals and plants are able to disperse themselves across the barriers at present existing.

It is scarcely necessary to draw attention to the facilities for diffusion possessed by animals endowed with great locomotive powers, and especially, among land-animals, by those having the power of flight; and in connection with this means of dispersal the most important thing to note is that some animals, which in the adult state have only feeble powers of locomotion, are better endowed in this respect in an earlier stage of existence. Such, for example, are univalve and bivalve marine molluscs, which are all developed from free-swimming larvæ.

But, besides the normal means of locomotion, there are many other modes of dispersal which it is highly important, with reference to the present inquiry, to take into account. First, there is the power of winds as a distributing agent. The carrying power of winds is known to be sufficient to bear along in the air fine dust across seas many hundreds of miles in width; and, that being the case, we have in that agency alone an adequate means of accounting for the dispersion of all plants propagated by minute spores. For that reason the distribution of most cryptogamic plants hardly forms part of the problem under consideration, and is generally left out of account by those who have devoted themselves to this investigation. What part winds may have played in carrying the seeds of phanerogamous plants across arms of the sea is a more doubtful point; but there are observations which show that even for such seeds, especially when provided with some kind of feathery appendage, winds may occasionally serve as a means of transport for very long distances. Thus, Berthelot records that after a violent hurricane he saw an annual belonging to the Compositæ (*Erigeron ambiguus*), widely distributed throughout the Mediterranean region, suddenly appear at various spots on the Canary Islands, where it was previously unknown, so that there could be hardly any doubt that the seeds had been blown across from Portugal or North Africa. Nevertheless, De Candolle has shown that seeds provided with a pappus are not on an average more widely distributed than those members of the Compositæ which are not so provided, so that such a case as that just mentioned must be looked upon as quite exceptional. But it is exceptional means of transport that is most important to consider with reference to the problems of distribution.

But, in the case of animals also, winds are a more important means of transport than one might at first suppose. Birds and insects are often blown immense distances out of their course; and to this cause, for instance, is due the arrival every year of American birds on the Bermudas. Insects have been caught on board of ships upwards of 300 miles from land. Further, there are well-authenticated cases of even crabs, frogs, and fishes being carried long distances by storms; and in this way it is possible to account for the transference of fish, &c. from [illegible] another. Still more frequently, [illegible] are the eggs of such creatures [illegible] means.

Next, marine currents also form, beyond doubt, a highly important means of dispersal both for plants and animals, and that in various ways. First, seeds may float on the surface of the ocean, and be carried by currents for hundreds of miles, and become stranded on a distant shore still in a condition fit for germination. The well-known experiments of Darwin to determine the vitality of seeds in sea-water first enabled us to appreciate the importance of this factor in the distribution of plants. In one experiment he found that, out of 87 kinds of seeds, 64 germinated after an immersion of 28 days, and a few survived an immersion of 137 days; and in another, that, out of 94 dried plants, 18 floated for above 28 days; and, combining the results of the two experiments, he concluded that 14 plants out of every 100 in the flora of a country might be floated by currents moving at the average rate of the several Atlantic currents a distance of 924 miles, and might, on being stranded, furnish seeds capable of germinating.

But further, marine currents often carry on their surface various kinds of natural rafts, which may be the means of transport both for plants and animals. In the polar regions icebergs and ice-floes may serve this purpose; and elsewhere trunks of trees, and even fragments torn from the land. Such fragments, forming small islands with erect trees upon them, have been seen at a distance of 100 miles from the mouth of the Ganges and other rivers. Wallace points out that ocean waifs of one kind or another are almost the only means we can imagine by which land-shells can have acquired the wide distribution for which they are remarkable. These molluscs perish very readily in sea-water, but, on the other hand, are very tenacious of life in other circumstances; and this tenacity of life obviously favours their chance of being carried in chinks of floating timber, or otherwise, across the ocean.

Again, locomotive animals are very frequently the means of dispersing both plants and other animals. Seeds may be attached to the fleece or fur of mammals or the plumage of birds, or may be enclosed in clumps of earth clinging to the feet or some other part of bird or beast, even of insects. To Darwin we are again indebted for an instance showing how likely a means of transport this is. He informs us that he received from Professor Newton the leg of a red-legged partridge (*Caccabis rufa*) with a ball of hard earth weighing 6¼ ounces adhering to it. The earth had been kept for three years; but when broken, watered, and covered by a bell-glass, as many as eighty-two plants sprang from it. Hooked fruits, such as those of agrimony, geum, &c., and fruits covered with a viscous substance, like those of some thistles, mistletoe, and others, are the most likely to be transported in this way. It seems probable that aquatic birds and water-beetles have been the means of distributing aquatic plants and fresh-water molluscs, which are remarkable for their wide diffusion; and the spawn of amphibians and fresh-water fishes may be conveyed from one body of fresh water to another by the same means.

Again, seeds with hard shells are known in many cases to be capable of passing through the digestive organs of birds uninjured; and consequently fruits enclosing such seeds, or, like the strawberry, covered with them, may be devoured by birds in one place, and deposited by them in a state fit for germination at another, hundreds of miles distant. And what is of still more importance, seeds which would be destroyed if they passed through the digestive organs of a bird are quite uninjured as long as they remain in the crop, where they may be retained for twelve or eighteen hours; and thus birds killed with food in their crop may be the means of scattering seed which has travelled 500 miles. It is obvious that the migratory habits of certain birds are of great importance with reference to both the means of transport just mentioned. Some seeds retain the power of germination even after passing through the digestive organs of ruminants. There is a well-established case of a tree belonging to the order Leguminosæ having been introduced into the West Indies through cattle brought from

South America, the cattle having been fed on the voyage with the pods belonging to the tree.

Further, the parasitic habits of certain animals enable them to be carried about from place to place, when they have themselves no power, or only a very feeble power of locomotion. And, with regard to the subject now under consideration, it makes no difference whether the animals are truly parasitic, feeding at the expense of the host to which they are attached, or merely commensalists, gaining their own food independently, like the sea-anemones so frequently attached to the shells of hermit-crabs.

Lastly, man is often unintentionally the means of conveying both plants and animals from one region to another. The foreign plants found growing on ballast-heaps are instances of this, and so also are the plants which have sprung from seed introduced with imported grain or other articles of import. Since the discovery of America the whole of the northern part of the continent is said to have been more or less overrun by European weeds; and, according to Agassiz, the roadside weeds of the New England states, to the number of 130, are all European. Wherever European sailors have gone, the European rats, both black and brown, have accompanied them; and the shrew, the death's-head moth, the *Sphinx convolvuli*, &c., are also known to have been introduced into various countries in ships.

In the preceding summary of the more important means of diffusion for plants and animals, some of the obstacles to diffusion have been incidentally referred to; but it will be convenient to make a general survey of these also.

For all land-plants and land-animals the most obvious and effective barrier is a wide expanse of ocean; and where the expanse is very wide it is seldom passable except with the aid of man. For land-mammals the ocean is an absolutely impassable barrier, and hence native mammals are always absent from oceanic islands (i.e. islands that have never been connected with the mainland); and this barrier is almost equally effective for serpents and amphibians, which also are nearly always wanting where there are no native mammals. Lizards are more frequently found indigenous on oceanic islands, though their means of transit from the mainland is unknown. Arms of the sea and broad rivers are likewise generally impassable for the creatures mentioned, though some of them have greater powers of swimming than is generally supposed. The jaguar, the bear, and the bison are capable of swimming the widest rivers; pigs have been known to swim ashore when carried out to sea to a distance of several miles; and even a boa constrictor, it is said, has swum to the island of St Vincent from the South American coast—a distance of 200 miles.

Mountains, and especially high mountains, are also frequently effective barriers to the migration of land plants and animals; but it must be noticed that in some cases they serve for both as a means of communication between one region and another, enabling plants and animals belonging to a cold climate, for example, to spread into latitudes where, in the plains, the climate is too hot for them. Again, deserts act as a barrier to the majority of plants and animals; forests are a barrier to the camel, hare, zebra, giraffe, &c.; treeless regions to apes, lemurs, and many monkeys; plains to wild goats and sheep. Broad rivers also act occasionally as barriers to distribution, and that, strange to say, even in the case of some species of birds.

Another important barrier is that of climate; but, with reference to this, it must be observed that the question of climate affects the problems of geographical distribution, in the proper sense of that term, only in so far as climatic conditions may shut off plants and animals from means of communication between one region and another, and not where climate merely limits the range of a species or group within a continuous area. In the case of many animals climate acts only indirectly as a barrier through limiting the food-supply required by them.

Another set of barriers may be classed under the general head of organic, inasmuch as they are all connected with the vegetable or animal life of the region where such barriers exist. Under this head may be mentioned first the fact that certain animals require for their subsistence a special kind of vegetable food. The range of insects is peculiarly liable to be limited in this way, certain insects being attached to particular species of plants, and others to genera or families; and for this reason insects, in spite of the exceptional facilities for dispersal which, as we have already seen, they enjoy, are remarkable, as a rule, rather for the restriction of their areas of distribution than for their wide diffusion. Again, the presence of enemies is sufficient in some cases absolutely to exclude certain forms from certain areas, as the well-known tse-tse fly does horses, dogs, and cattle from a well-defined area in South Africa; and another kind of fly prevents horses and cattle from running wild in Paraguay, as they do in abundance both to the north and south of that region.

But a more important, because more generally operative, organic barrier consists in the fact of a region being already fully occupied by a native flora and fauna, so that there is no room for new-comers. Hence it happens that seeds may be wafted in plenty from one country to another without a single plant growing from these seeds being able to establish itself; and there may even be, as in South America, a free communication with another region while the fauna remains strikingly distinct, simply because that portion of the American continent is already completely stocked with a fauna perfectly adapted to the physical conditions there prevailing.

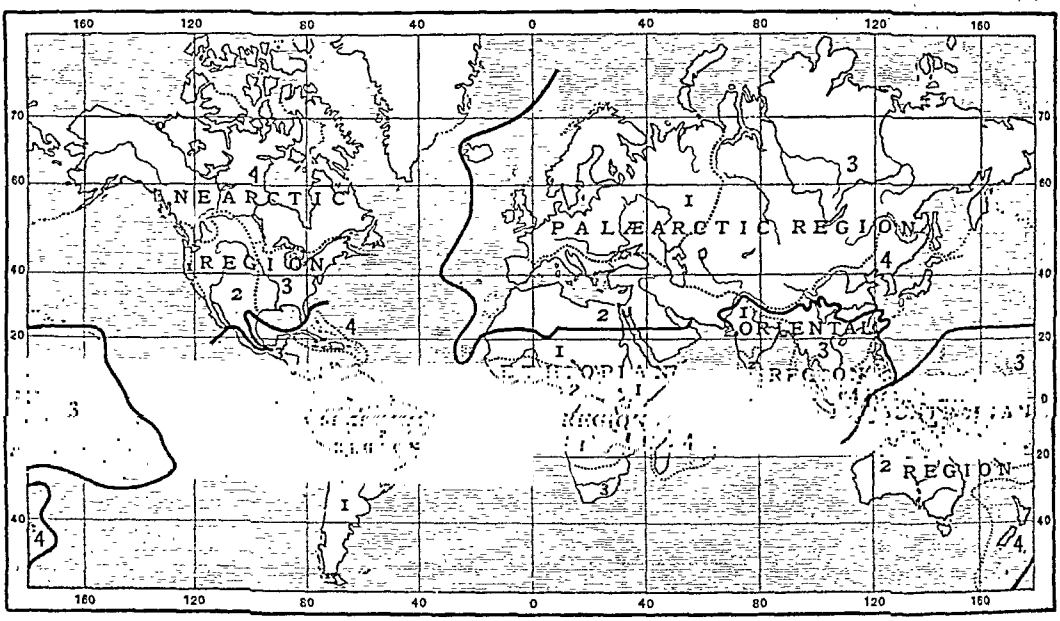
The barriers to the spread of marine creatures are not so numerous as in the case of terrestrial forms. The freedom of communication between one part of the ocean and another makes it impossible to mark out any marine zoogeographical regions, though many seas and coasts are distinguished by characteristic fishes and other marine creatures. The principal barriers for fish are temperature and the intervention of land. Thus, the Isthmus of Panama is at present a complete barrier for fishes requiring warm seas.

If all the barriers to migration had existed in all past time as they are now, it would be quite impossible to explain the present distribution of plants and animals on the supposition that kindred groups have had a common birthplace. But the solution of the problems of distribution is to be found in the fact that all the barriers are liable to change. Of changes of sea and land geology supplies us with abundant evidence. Portions of the mainland now continuous were at one time severed by arms of the sea; and islands have been formed by the severance of portions of land that once belonged to the mainland. Such islands are known as continental islands, and the study of their faunas and floras is one of peculiar interest in connection with geographical distribution. These faunas and floras show, as might be expected, a greater or less degree of correspondence with those of the mainland from which the islands have been cut off; and the resemblance is the closer the more recently the land connection has been destroyed. The relative date of the disunion is usually approximately indicated by the depth

of the sea which now separates island and mainland, shallow seas dividing portions of land that have only recently been disconnected, and deeper seas separating those which have been longer apart.

The most remarkable case of isolation is presented by the Australian region, the fauna and flora of which are the most peculiar in the world. In the widest sense, this region includes not only the vast island of Australia itself, but also New Guinea and all the Malayan and Pacific islands to the east of a deep channel between the islands of Bali and Lombok—a channel the significance of which, as a boundary line for plants and animals, was first pointed out by Wallace, the great authority on animal distribution, and hence known as Wallace's Line. The great feature of this region (so far as animal distribution is concerned) is 'the almost total absence of all the forms of mammalia which abound in the rest of the world, their place being taken by a great variety of marsupials.' The family just mentioned, though now restricted in the manner stated at the beginning of this article, was at one time spread over the whole world, but has in most parts become extinguished by the competition of later types; thus presenting one of the best examples of what are known as discontinuous areas of distribution, and offering an illustration of the mode in which such discontinuity is usually brought about. The early severance of the Australian region from the Asiatic continent (a severance which must be referred to some period in the Secondary Age of geologists) saved the Australian marsupials from the competition which almost extinguished the group elsewhere.

Turning now to marine distribution, we find evidence of the former absence of a land-barrier at the Isthmus of Panama in the identity of many species of fish on both sides of the isthmus.



The Zoogeographical Regions according to A. R. Wallace:

Sub-regions of Palæarctic Region—
1. European.
2. Mediterranean.
3. Siberian.
4. Manchurian.

Sub-regions of Ethiopian Region—
1. East African.
2. West "
3. South "
4. Malagasy.

Sub-regions of Oriental Region—
1. Indian.
2. Ceylonese.
3. Indo-Chinese.
4. Indo-Malayan.

Sub-regions of Australian Region—
1. Austro-Malayan.
2. Australian.
3. Polynesian.
4. New Zealand.

Sub-regions of Neotropical Region—
1. Chilian.
2. Brazilian.
3. Mexican.
4. Antillean.

Sub-regions of Nearctic Region—
1. Californian.
2. Rocky Mountain.
3. Alleghanian.
4. Canadian.

Changes in the climatic barrier have also had an important influence on geographical distribution; and it is by such changes, combined with changes in the continuity of land in the north polar regions, that the affinities between the floras of Japan and eastern North America must be explained. When these affinities were first pointed out by Asa Gray, that distinguished botanist divined the true explanation—viz. that in former geological epochs a genial climate must have prevailed even within the polar circle, so as to allow of the existence of a remarkably uniform flora, suitable to such a climate, all round the pole in very high latitudes; and that as the climate became colder in the north this flora was driven southwards, and became differentiated according to the differences of climate in the more southerly latitudes to which it advanced. Hence the eastern parts of America and Asia, as they correspond pretty much in climate, came to correspond also more closely than other tracts in the same latitude in the character of their floras. The soundness of this surmise was afterwards confirmed by the discovery of abundant plant remains of the Miocene age, indicating a warm climate in Greenland, Spitzbergen, and elsewhere. The effects on distribution of the changes of climate belonging to the period known as the Glacial Period (q.v.) or Ice Age must be alluded to here, but there is no space to do more.

As the result of all the processes of dispersal across the various barriers to migration, and of the changes in these barriers, we have the present distribution of plants and animals, which is such as to enable us to divide the terrestrial surface of the globe into more or less well-marked regions. For animals the regions adopted by Wallace are nearly the same as those first suggested by Sclater as applicable to the distribution of birds;

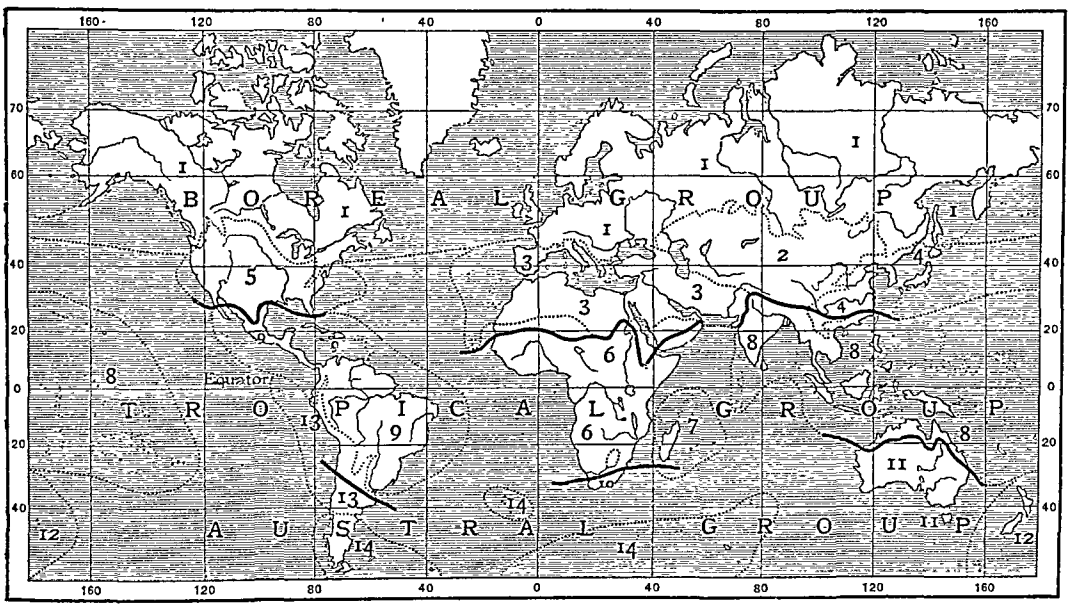
for, in spite of the exceptional facility which birds have for crossing barriers impassable by mammals, Wallace finds that the distribution of mammals (which afford the best means of marking off zoogeographical regions) corresponds with that of birds to an extent that one would not perhaps have previously anticipated. But with regard to these regions it must be remembered (1) that it is impossible in most cases to draw any very clearly marked boundary line between one region and another; (2) that the degree of divergence between different regions is different in different cases; and (3) that, when any two regions are compared, we have not the same degree of divergence between different groups of the animal kingdom, or between animals and plants belonging to the two regions. Obviously, the degree of correspondence depends largely on the facilities for dispersal, and largely also on the geological age of different groups; and both of these are varying factors. These considerations being premised, we may now state briefly the limits of the six zoological regions adopted by Wallace, as given in his *Island Life*. In the space to which the present article is necessarily restricted it is impossible to give even the most fragmentary sketch of the characteristic life of the different regions, for which the reader must be referred to the works cited at the end of the article.

(1) Palæarctic Region, including Europe and north temperate Asia and Africa to the northern borders of the Sahara.

(2) Ethiopian Region, consisting of all tropical and South Africa, together with Madagascar and the Mascarene Islands.

(3) Oriental Region, comprising all Asia south of the Palæarctic limits, and along with this the Malay Islands as far as the Philippines, Borneo, and Java.

(4) Australian Region, as already defined and characterised. Celebes might be referred almost with equal right to this or the previous region. New Zealand is



The Terrestrial Floral Domains according to Oscar Drude:

1. Northern.
2. Inner Asiatic.
3. Mediterranean.
4. Eastern Asiatic.
5. Central North American.
6. Tropical African.
7. East African Islands.
8. Indian.
9. Tropical American.
10. South African.
11. Australian.
12. New Zealand.
13. Andine.
14. Antarctic.

treated by Wallace as a highly peculiar sub-region of this great region.

(5) Nearctic Region, comprising all temperate and arctic North America, including Greenland, and extending on the south to an irregular line running from the Rio Grande del Norte on the east to a point nearly opposite Cape St Lucas on the west.

(6) Neotropical Region, the American continent south of this line, together with the West Indian Islands.

Heilprin (see below) and others advocate the union of the Nearctic and Palæarctic regions under the name of Holarctic, and introduce three transitional tracts (the Mediterranean, embracing southern Europe, northern Africa, and western Asia south of the Caspian and west of India, but exclusive of the southern half of Arabia; the Sonoran tract, embracing the north-west of Mexico; and the Austro-Malaysian tract, embracing Celebes and the smaller islands lying between it and New Guinea and Australia). Otherwise his major faunal divisions of the globe are similar to those of Wallace.

On plant distribution the most important recent works are those of Engler and Drude (cited at the end of the article). Engler attempts to trace the history of the vegetable kingdom since the Tertiary period, and comes to the conclusion that already in the Tertiary period four 'floral elements' (*Florenelemente*) could be distinguished—namely:

(1) The Arcto-tertiary element, characterised by an abundance of conifers and numerous genera of trees and shrubs now prevalent in North America, or in extra-tropical eastern Asia and in Europe.

(2) The Palæotropical element, characterised by the presence of the families and sub-families dominant in the tropics of the Old World; and still more by the absence of certain families, groups, and genera found in the territory of the Arcto-tertiary element.

(3) The Neotropical or South American element, which, according to Engler, must have had in Tertiary times much the same character as that now possessed by tropical Brazil and the West Indies.

(4) The old Oceanic element, consisting of forms which possessed the power of traversing considerable stretches of ocean and developing further on islands.

The modern provinces of the vegetable kingdom are subordinated by Engler to these great divisions. Drude, in the first place, distinguishes the oceanic

(marine) flora from the terrestrial forms, and the latter he divides into three great groups, and these again into fourteen floral domains (*Florenreiche*), the limits of which are shown on the accompanying map.

See P. L. Sclater's paper on the Geographical Distribution of Birds, in the *Jour. Linn. Soc.* (*Zool.*), vol. ii., and his Address to the Biological Section of the Brit. Assoc. at Bristol, 1875; A. R. Wallace's *Geographical Distribution of Animals* (2 vols. Lond. 1876), and his *Island Life* (Lond. 1880); A. Murray's *Geographical Distribution of Mammals* (Lond. 1866); Angelo Heilprin, *The Geographical and Geological Distribution of Animals* (New York and Lond. 1887); Bentham's Presidential Address to the Linnean Society, *Jour. Linn. Soc.*, x. (Botany, introd.); A. de Candolle's *Géographie Botanique* (2 vols. Paris, 1855); Sir J. Hooker's *Introduction to the Flora of Tasmania*, and *Handbook of the Flora of New Zealand*; also papers by him On Insular Floras, Brit. Assoc. 1866, and On the Distribution of Arctic Plants, *Trans. Linn. Soc.*, xxiii.; Asa Gray's Forest Geography and Archæology, in *Amer. Jour. of Science and Arts* (ser. iii. vol. xvi. 1875); Grisebach's *Vegetation der Erde* (Leip. 1872; 2d ed. 1884), and French version of the same with valuable notes, by P. de Tchihatchef (2 vols. Paris, 1875-78); Ad. Engler's *Entwicklungsgeschichte der Pflanzenwelt seit der Tertiärperiode* (2 vols. Leip. 1879-82); Oscar Drude, *Die Florenreiche der Erde* (Ergänzungsheft, No. 74, to *Petermann's Mitteilungen*, Gotha, 1884); and the chapters on Geographical Distribution in Darwin's *Origin of Species*, as well as chap. xxxviii.-xlii. of Lyell's *Principles of Geology*.

Geography (Gr. *gē*, 'the earth;' *graphein*, 'to describe') etymologically means a description of the earth. The term as now accepted by its most competent students is applied to that department of science whose function it is to investigate the features of the earth's surface, and the distribution and mutual topographical relations of all which that surface sustains. It thus involves a study of the atmosphere or air-covering; the geosphere or land-surface; and the hydrosp
The basis of geography is
topographical relations and
understand this thoroughly a certain elementary knowledge of various departments of science is necessary; and this knowledge is often included in what is somewhat vaguely known as Physiography (q.v.). To understand what may be regarded as the subject proper of geography—viz. the features of the earth's surface, their distribution and relations, and the distribution and relations of the denizens of the surface—some knowledge is required of the relations of the earth to the sun and the other members of the solar system, and of the celestial sphere generally. For exact topographical observation (see SURVEYING) a precise knowledge of certain astronomical data is required. This department is treated in the ordinary text-books under the heading of Astronomical or Mathematical Geography. An elementary acquaintance is also advisable with certain physical and chemical facts and laws, in order to understand the action of the atmosphere, of wind, rain, ice, and water (rivers, lakes, the ocean), and those other factors which help to constitute climate, and which do so much to shape those features with which geography has chiefly to deal. Equally useful is a general knowledge of the character of the great classes of rocks which compose the surface, and of the leading families of plants and animals which cover it, especially those of economical importance. This, though strictly preliminary, is often included along with a study of the features themselves, in Physical Geography. The investigation of the ocean and its denizens has recently been made a new department under the title of Oceanography or Thalassography. Again, to an account of the different states or communities into which man is divided the term Political Geography is commonly applied. Commercial Geography discusses the various countries and regions of the earth with special reference to their products and their requirements as affecting trade and commerce; and Medical Geography deals with localities as liable to become the seats of special diseases or groups of diseases.

Of course any section of geography may be treated and studied by itself, just as in the case of geology, or chemistry, or physics. But for purposes of research, for practical results, and even for educational uses, it is now considered more satisfactory to treat geography as one whole, dealing with the characteristics, distribution, and mutual relations of the great features of the earth's surface, the great classes of plants and animals which cover that surface, and of man himself. Such a study, it is maintained, is not only an excellent discipline, but the knowledge of facts and laws so obtained can be applied in many useful practical directions. Most of all it may be applied to the distribution of man in communities or states, and so, combined with other considerations, lead to a rational study of political geography and the course of history. In the same way the knowledge may be applied in the interests of industry, of commerce, of colonisation, and in many other economical directions. Geography, when thus treated, is, it is maintained, both more interesting and more profitable than when dealt with as a mere collection of unconnected facts and factors. It has long been so treated in Germany by such geographers as Ritter and Peschel, and their followers, and similar views are rapidly prevailing in England and America. In Germany the subject is often divided into general physical and political, and special physical and political geography, the latter, of course, dealing with particular countries or regions. Of course, like all other departments of learning, the subject may be broken up into sections, and dealt with for teaching purposes, and in a more or less elementary manner. For the most elementary stage, it is now generally considered advisable to begin with the immediate topographical surroundings of the pupil and proceed outwards. It should be stated that the eminent German geographer, Professor G. Gerland, maintains that geography has to do with the earth as a whole, and that the human side of it, or anthropogeography, belongs exclusively to history.

Special aspects of geography will be found treated under ANTHROPOLOGY, ASTRONOMY, CLIMATE, CLOUDS, EARTH, ETHNOLOGY, GEOGRAPHICAL DISTRIBUTION, GEOLOGY, GLOBE, HEAT, LAKES, LATITUDE AND LONGITUDE, MOUNTAINS, RAIN, RIVERS, SEA, WINDS, &c. As authorities to consult on the various aspects of geography referred to, may be mentioned Ritter's *Erdkunde*; Mrs Somerville's *Physical Geography* (latest edition); Peschel's *Physische Erdkunde*, *Abhandlungen zur Erd- und-Völkerkunde*, and *Neue Probleme der Vergleichenden Erdkunde*; Suess, *Das Antlitz der Erde*; Ratzel, *Anthropogeographie*; *Unser Wissen von der Erde*: I. *Allgemeine Erdkunde*; Hinman's *Eclectic Physical Geography*; the volume of 'Education Reports' issued by the Royal Geographical Society, and the Lectures contained therein; General R. Strachey, *Lectures in Geography*; 'The Scope and Methods of Geography,' by H. J. Mackinder in *Proc. Roy. Geog. Soc.* (vol. ix.); 'Scientific Earth-knowledge as an Aid to Commerce,' by H. R. Mill in *Scot. Geog. Mag.* (vol. v. p. 302); 'Applied Geography,' by J. S. Keltie in *Contemp. Rev.* (Sept. 1888); Chisholm's *Handbook of Commercial Geography* (1889).

The facts of Political Geography will be found under the headings of the different continents, countries, and towns in this Encyclopædia. As authoritative works on the subject (both general and political) may be mentioned Reclus, *Géographie universelle* (with its English translation); and Stanford's *Compendium of Geography and Travel*.

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must be made to the articles on continents and oceans,

and also to the articles on CHARTS and MAPS. Here only general reference can be made to the progress of correct notions of the earth and, in connection therewith, of a general knowledge of the extent and form of the earth's surface. As the earliest efforts, within the historical period, to extend a knowledge of the earth's surface began with the Mediterranean nations of antiquity, it is natural and right to start there, although in one sense exploration is coeval with humanity.

The earliest definite idea formed of the earth by nations emerging from a primeval condition seems to have been that of a flat circular disc, surrounded on all sides by water, and covered by the heavens as with a canopy, in the centre of which their own land was supposed to be situated. The Phœnicians were the first people who communicated to other nations a knowledge of distant lands; and, although little is known as to the exact period and extent of their various discoveries, they had, before the age of Homer, navigated all parts of the Euxine, and penetrated beyond the limits of the Mediterranean into the Western Ocean; and they thus form the first link of the great chain of discovery which, 2500 years after their foundation of the cities of Tartessus and Utica, was carried by Columbus to the remote shores of America. Besides various settlements nearer home, these bold adventurers had founded colonies in Asia Minor about 1200 B.C.; a century later they laid the foundation of Gades, Utica, and several other cities, which was followed in the course of the 9th century by that of Carthage, from whence new streams of colonisation continued for several centuries to flow to parts of the world hitherto unknown. The Phœnicians, although less highly gifted than the Egyptians, rank next to them in regard to the influence which they exerted on the progress of human thought and civilisation. Their knowledge of mechanics, their early use of weights and measures, and, what was of still greater importance, their employment of an alphabetical form of writing facilitated and confirmed commercial intercourse among their own numerous colonies, and formed a bond of union which speedily embraced all the civilised nations of Semitic and Hellenic origin. So rapid was the advance of geographical knowledge between the age of the Homeric poems (which may be regarded as representing the ideas entertained at the commencement of the 9th century B.C.) and the time of Hesiod (800 B.C.) that, while in the former the earth is supposed to resemble a flat circular shield, surrounded by a rim of water spoken of as the parent of all other streams, and the names of Asia and Europe are applied only, the former to the upper valley of the Cayster, and the latter to Greece north of Peloponnesus, Hesiod mentions parts of Italy, Sicily, Gaul, and Spain, and is acquainted with the Scythians and with the Ethiopians of southern Africa. During the 7th century B.C. certain Phœnicians, under the patronage of Neku or Necho II., king of Egypt, undertook a voyage of discovery, and are reported to have circumnavigated Africa. This expedition is recorded by Herodotus, who relates that it entered the Southern Ocean by way of the Red Sea, and after three years' absence returned to Egypt by the Pillars of Hercules. The fact of an actual circumnavigation of the African continent has been doubted, but the most convincing proof of its probability is afforded by the observation which seemed incredible to Herodotus—viz. 'that the mariners who sailed round Libya (from east to west) had the sun on their right hand.' The 7th and 6th centuries B.C. were memorable for the great advance made in regard to the knowledge of the form and extent of the earth. Thales, and his pupil Anaximander, reputed to have been the first to draw maps, exploded many errors, and paved the way by their observations for the attainment of a sounder knowledge. The logographers contributed at this period to the same end by the descriptions which they gave of various parts of the earth; of these perhaps the most interesting to us is the narrative of the Carthaginian Himilco, who discovered the British Islands, including the Œstrymnides, which he described as being a four months' voyage from Tartessus.

With Herodotus of Halicarnassus (born 484 B.C.), who may be regarded as the father of geography as well as of history, a new era began in regard to geographical knowledge. Although his chief object was to record the struggles of the Greeks and Persians, he has so minutely described the countries which he visited in his extensive travels (which covered an area of more than 31° or 1700 miles from east to west, and 24° or 1660 miles from north to south) that his History gives us a complete representation of all that was known of the earth's surface in his age. This knowledge was extremely scanty. It was believed that the world was bounded to the south by the Red Sea or Indian Ocean, and to the west by the Atlantic, while its eastern boundaries, although admitted to be undefined, were conjectured to be nearly identical with the limits of the Persian empire, and its northern termination somewhere in the region of the amber-lands of the Baltic, which had been visited by Phœnician mariners, and with which the people of Massilia (the modern Marseilles) kept up constant intercourse by way of Gaul and Germany. In the next century the achievements of Alexander the Great tended materially to enlarge the bounds of human knowledge, for while he carried his arms to the banks of the Indus and Oxus, and extended his conquests to northern and eastern Asia, he at the same time promoted science, by sending expeditions to explore and survey the various provinces which he subdued, and to make collections of all that was curious in regard to the organic and inorganic products of the newly-visited districts; and hence the victories of the Macedonian conqueror formed a new era in physical inquiry generally, as well as in geographical discovery specially.

While Alexander was opening the East to the knowledge of western nations, Pytheas, an adventurous navigator of Massilia, conducted an expedition past Spain and Gaul, through the Channel, and round the east of England into the Northern Ocean. There, after six days' sailing, he, according to some, reached Thule (conjectured to be Iceland, although the actual locality is very uncertain), but according to the most competent interpreters of the story only heard of it. Returning, he passed into the Baltic, where he heard of the Teutones and Goths. Discovery was thus being extended both in the north and east into regions whose very existence had never been suspected, or which had hitherto been regarded as mere chaotic wastes. An important advance in geography was made by Eratosthenes (born 276 B.C.), who first used parallels of longitude and latitude, and constructed maps on mathematical principles. His work on geography is lost, yet we learn from Strabo that he considered the world to be a sphere revolving with its surrounding atmosphere on one and the same axis, and having one centre; although the belief in the spherical form of the earth was at the time confined to the learned few. He believed that only about one-eighth of the earth's surface was inhabited, while the extreme points of his habitable world were Thule in the north, China in the east, the Cinnamon Coast of Africa in the south, and the Prom. Sacrum (Cape St Vincent) in the west. During the interval between the ages of Eratosthenes and Strabo (born 66 B.C.) many voluminous works on geography were compiled, which have been either wholly lost to us,

or only very partially preserved in the records of later writers. Strabo's great work on geography, which is said to have been composed when he was eighty years of age, has been considered as a model of what such works should be in regard to the methods of treating the subject; but, while his descriptions of all the places he has himself visited are interesting and instructive, he seems unduly to have discarded the authority of preceding writers.

The wars and conquests of the Romans had a most important bearing upon geography, since the practical genius of the Roman people led them to the study of the material resources of every province and state brought under their sway; and the greatest service was done to geographical knowledge by the survey of the empire, which was begun by Julius Cæsar, and completed by Augustus. This work comprised a description and measurement of every province by the most celebrated geometricians of the day. Pliny (born 23 A.D.), who had travelled in Spain, Gaul, Germany, and Africa, has left us a compendium of the geographical and physical science of his age in the four books of his *Historia Naturalis* which he devotes to the subject. He collected with indefatigable industry the information contained in the works of Sallust, Cæsar, and others, to which he added the results of his own observations, without, however, discriminating between fact and fiction. The progress that had been made since Cæsar's time in geographical knowledge is evinced by Pliny's notice of arctic regions and of the Scandinavian lands, and the accounts which he gives of Mount Atlas, the course of the Niger, and of various settlements in different parts of Africa; while his knowledge of Asia is more correct than that of any of his predecessors, for he correctly affirms that Ceylon is an island, and not the commencement of a new continent, as had been generally supposed.

The study of geography in ancient times may be said to have terminated with C. Ptolemy, who flourished in the middle of the 2d century of our era. His work on Geography, in eight books, which continued to be regarded as the most perfect system of the science through the dark and middle ages down to the 16th century, gives a tolerably correct account of the well-known countries of the world, and of the Mediterranean, Euxine, and Caspian, together with the rivers which fall into those seas; but it added little to the knowledge of the north of Europe, or the extreme boundaries of Asia or Africa. Yet, from his time till the 14th century, when the records of the travels of the Venetian Marco Polo opened new fields of inquiry, the statements of Ptolemy were never questioned, and even during the 15th century it was only among a few German scholars at Nuremberg that the strange accounts given of distant eastern lands by the Venetian traveller were received as trustworthy where he differed from Ptolemy. Marco Polo had, however, unfortunately made no astronomical observations, nor had he even recorded the length of the day at any place, and hence the Nuremberg geographers, who had no certain data for estimating the extent of the countries which he had traversed, were the means of propagating errors which led to results that were destined to influence the history of mankind. For, taking Ptolemy's tables as their basis, they incorporated on their globes and maps the results of their own rough estimates of the length of Marco Polo's days' journeys, and they thus represented the continent of Asia as extending across the Pacific, and having its eastern shores somewhere in the region of the Antilles. These erroneous calculations misled Christopher Columbus to the false assumption that, by sailing 120° W., he would reach the wealthy trading marts of China, and the result of this conviction was his entering upon that memorable expedition which terminated in the discovery (in 1492) of the continent of America. Although there can be no doubt that the American continent was visited in the 9th and 10th centuries by Northmen, the event remained without influence on the history of discovery, and cannot therefore detract from the claims of Columbus. This momentous discovery, which had been preceded in 1486 by the exploration of the African coast as far as the Cape of Good Hope (which was doubled by Vasco da Gama in 1497), was followed by a rapid succession of discoveries. Within thirty years of the date of the first voyage of Columbus the whole coast of America from Greenland to Cape Horn had been explored, the Pacific Ocean had been navigated, and the world circumnavigated by Magellan (q.v.); the coasts of eastern Africa, Arabia, Persia, and India had been visited by the Portuguese, and numerous islands in the Indian Ocean discovered.

The 16th century was marked by continued attempts, successful and unsuccessful, to extend the sphere of oceanic discovery; and the desire to reach India by a shorter route than those of the Cape of Good Hope or Cape Horn led to many attempts to discover a north-west passage, which, though they signally failed in their object, had the effect of very materially enlarging our knowledge of the arctic regions. The expeditions of Willoughby and Frobisher in 1553 and 1576, of Davis (1585), Hudson (1607), and Baffin (1616), were the most important in their results towards this end. The 17th and 18th centuries gave a new turn to the study of geography, by bringing other sciences to bear upon it, which, in their turn, derived elucidation from the extension of geographical knowledge; and it is to the aid derived from history, astronomy, and the physical and natural sciences that we owe the completeness which has characterised modern works on geography. In the 17th century the Dutch, under Tasman and Van Diemen, made the Australasian islands known to the civilised world; and in the latter half of the 18th century Captain Cook (q.v.) extended the great oceanic explorations by the discovery of New Zealand and many of the Polynesian groups, and by proving the non-existence of a 'great Antarctic continent,' stretching far north in the Pacific. The antarctic lands were first visited in 1840 by American, English, and French expeditions, under their respective commanders, Wilkes, Ross, and Dumont d'Urville. Polar exploration, after having been for a time in abeyance, has within late years been vigorously prosecuted by the United States and various European countries; and in 1879–80 Baron Nordenskjöld succeeded for the first time in history in navigating the north-east passage round Europe and Asia. In America the travels of Humboldt, Lewis and Clark, Frémont, and others, and the work of the United States and Canadian Surveys, of the Argentine government explorers, and of railway pioneers, have done much to make us acquainted with broad general features, but much remains to be done in regard to special districts of central and southern America. In Asia numerous [illegible] and naturalists, combined w[illegible] Russian armies, and explorers like the late General Prejevalsky, have contributed to render our knowledge precise and certain in respect to a great part of the continent, whose natural characteristics have been more especially represented by the great physicist Ritter; while we owe a large debt of gratitude to the Jesuit missionaries, whose indefatigable zeal has furnished us with a rich mass of information in regard to minor details of Asiatic life and nature, nor must the work of the Indian

Survey and its European and native explorers be forgotten. In Africa much light has been thrown on the character and condition of the African continent by many of its greatest explorers—as Bruce, Park, Clapperton, the Landers, Burton, Speke, Barth, Vogel, Livingstone, Cameron, Stanley, Thomson, Schweinfurth, Nachtigal, Junker, and Emin Pasha; General Gordon and his subordinate officers; the French in Senegambia and on the Upper Niger; Wissmann and Pogge, and other officers of the Congo Free State; German explorers in east and central Africa, and the missionaries of various denominations. In Australia, although much still remains to be done, the obscurity which hung over the interior has been to a great extent diminished by the explorations of Sturt, Eyre, Leichhardt, and the brothers Gregory; and still more by the highly important labours of Burke and Wills, who in 1860 crossed the Australian continent from Melbourne to Carpentaria. The establishment in 1872 of a telegraph line from Adelaide to Port Darwin right across the continent, and the maintenance of stations along the line, formed an admirable base for further exploration. Giles, Warburton, and Forrest forced their way in nearly parallel lines to the west coast. The labours of these and other explorers indicate that much of the continent of Australia, though often covered with dense growth of spinifex, acacia, and eucalyptus, is not available for colonisation by Europeans.

The government surveys of the various European countries, of the British possessions, and of other civilised states have not only added to a detailed knowledge of the face of the earth, but given us more precise ideas of its shape. Again, various deep-sea exploring expeditions of recent years, the chief among which was that sent out by the English government in the *Challenger* (q.v.), have added greatly to our knowledge of the geography of the oceans.

The progress of recent discovery has been aided by the encouragement given to exploration by the governments of different countries, and by the efforts of the numerous geographical societies, of which there are now over one hundred; while the constantly increasing mass of information collected by scientific explorers is rapidly diffusing correct information in regard to distant regions.

On the subject of geographical discovery, the following works may be consulted with advantage: Bunbury's *History of Ancient Geography* (1880); Vivien de Sainte-Martin's *Histoire de Géographie;* Kiepert's *Manual of Ancient Geography* (1881); *Précis de Géographie Universelle,* by Malte Brun; Humboldt's *Hist. crit. de l'Hist. de la Géographie,* and the *Cosmos;* Ritter's *Asien;* Kloeden's *Erdkunde;* Reclus, *Nouvelle Géographie Universelle;* Stanford's *Compendium of Geography and Travel,* based on Hellwald. The recent progress of geographical discovery may be traced in Petermann's *Mitteilungen,* the *Proc. Roy. Geog. Soc.,* and the *Geographisches Jahrbuch.*

Geology (Gr. *gē,* 'the earth;' *logos,* 'a discourse') is the science of the earth—that science, namely, which has for its object the study of the various constituents of the earth's crust, with a view to discover how those materials have been aggregated and caused to assume the appearances which they now present. Geology, in short, is an inquiry into the history and development of the earth's crust, and of the several floras and faunas which have successively clothed and peopled its surface. As a science geology is comparatively young, although it can hardly be doubted that from a very early period the phenomena with which it deals must have claimed some attention. It is easy, indeed, to trace in old mythologies and legends the influence of the geological features of the land upon the human imagination. Volcanic eruptions, earthquakes, avalanches, and landslips, the havoc of torrential waters, and the destructive action of waves and breakers have unquestionably left their impress upon the superstitions and beliefs of all primitive peoples. One may believe that many of the remarkable scientific premonitions which are met with in oriental cosmogonies and the early writings of the Greeks may have been suggested by geological phenomena. The occurrence of sea-shells in the rocks of mountains and regions far removed from the sea may well have given rise to the oriental belief in the alternate destruction and renovation of the world. Pythagoras and Strabo both recognised that changes had taken place on the surface of the earth, but neither appears to have got beyond the observation of a few obvious phenomena—their explanations of which are hardly entitled to be considered more than vague guesses. It is not until we reach the close of the 15th century that we find geological phenomena attracting the attention of competent observers. With the investigations of the celebrated painter, Leonardo da Vinci, together with those of Fracastoro, a new departure was taken. The numerous fossil shells discovered in engineering operations were appealed to by them as evidence of former geographical changes—their method of reasoning being consistent and logical. Unfortunately it did not convince either their contemporaries or immediate successors—some of whom held the extraordinary view that shells and other fossil organic remains were not really what they appeared to be, but the result of a plastic force which had somehow fashioned them in the bowels of the earth. Fossils were further supposed to be the results of the fermentation of fatty matter, or of terrestrial exhalations, or of the influence of the heavenly bodies, or, finally, to be simply earthy concretions or sports of nature. Others, however, while maintaining that fossils were in truth the relics of formerly living creatures, held the opinion that all these had been buried at the time of the Noachian deluge. This controversy lasted for more than a hundred years, but long after the true character of fossils had become generally admitted their entombment in the strata continued to be attributed to the action of the deluge. This belief prevailed through the 17th and 18th centuries, and sadly interfered with the growth of geology; the prolonged infancy of which must be largely attributed to its influence. Steno, a Dane, who lived in Italy in the middle of the 17th century, would appear to have been the first to observe a succession in the strata. Hitherto stratified rocks had not been differentiated; they were all lumped together as representing the tumultuous deposits of the Noachian deluge. Steno, however, distinguished between marine and fresh-water formations, and showed that there were rocks older than the fossiliferous strata in which no organic remains occurred. Nevertheless, this clear-sighted observer could not free himself from the fashionable hypotheses of his day. While a belief in the universality of the Noachian deluge was prevalent, many strange 'theories of the earth,' such as that by Bishop Burnet, saw the light. These showed not only how the world had been evolved out of chaos, how it fared before, during, and after the deluge, but in what precise manner it was eventually to be wound up and consumed. The 'theories' referred to differed in detail, but their imaginative authors agreed in the notion of an interior abyss, whence at the time of the Noachian catastrophe the waters rushed, breaking up and bursting through the crust of the earth to cover its surface, and whither, after the deluge, they returned again.

Leibnitz (1680) proposed the bold theory that the earth was originally in a molten state, and that

the primary rocks were formed by the cooling of the surface, which also produced the primeval ocean by condensing the surrounding vapours. The sedimentary strata resulted from the subsiding of the waters which had been put in motion by the collapse of the crust on the contracting nucleus. The process was several times repeated until at last equilibrium was established.

Hooke (1688) and Ray (1690) considered the essential condition of the globe to be one of change, and that the forces now in action would, if allowed sufficient time, produce changes as great as those of geological date. In Italy, Vallisneri (1720), Lazzaro Moro (1740), and his illustrator, Cirillo Generelli, taught that there had been depressions of the land, during which marine fossiliferous strata were deposited, and that subsequently the sea-bottom had been elevated by the subterranean forces, and converted into dry land. Moro maintained the impossibility of the whole earth having been covered by the waters of the sea up to the tops of the highest mountains. The continents, he said, had been upheaved, and the fractures and dislocations of the strata were pointed to in confirmation of this view. Generelli insisted upon the gradual degradation of the land by running water, and held that the waste was so great that eventually the mountains must be washed down to the sea. This inevitable degradation of the surface, however, would be counterbalanced, he inferred, by elevation of the land elsewhere. But as Italian geologists, in common with those of other countries, believed that the world was only some 6000 years old, Moro and Generelli found some difficulty in explaining how so many thousands of feet of strata could have been accumulated within the limited period allowed by the orthodox chronology. They suggested, therefore, that the materials entering into the formation of the strata had been largely derived from volcanic eruptions.

Eventually the more advanced views held in Italy spread into France, Germany, and England. Buffon (1749), by the publication of his *Theory of the Earth*, evoked a spirit of inquiry in France; Lehmann (1756), Fuchsel (1762), and others in Germany did much to establish more correct methods of observation and interpretation of geological phenomena than had hitherto prevailed; while in England a distinct advance was made by Michell (1760) in his essay on the Cause and Phenomena of Earthquakes. The next name that comes into prominence is that of Werner, professor of Mineralogy at Freiburg in Saxony (1775). This celebrated writer framed a classification or system of the rocks of the Harz Mountains, in the order of their succession, and consequently in that of their formation, and maintained that this order would be found to prevail generally throughout the world. Werner's classification has proved inadequate, and even in many respects erroneous. Nevertheless, to him belongs the great merit of having brought into prominence a definite principle in the construction of the earth's crust, and a precise method of geological investigation. This discovery of the fact that strata occur in a certain order of superposition had been anticipated by several Italian geologists, and by Lehmann in Germany, but Werner's fame as a brilliant investigator and attractive teacher overshadowed and eclipsed the most of his predecessors. In some respects the views of this eminent man were retrograde. He maintained, for example, that his 'formations' were universal, and had been precipitated over the whole earth in succession, from a common menstruum or chaotic fluid. The igneous rocks, according to him, were chemical precipitates from water; he believed that no volcanoes existed in the earlier ages of the world, but that volcanic action was exclusively of modern date. Yet the true nature of igneous rocks had already been recognised in Italy, France, England, and Germany. With the publication of Werner's views on this subject a great controversy began, which was carried on with an acrimony that is now hard to realise. Those who upheld the igneous origin of such rocks as basalt were styled Vulcanists, while those who followed Werner became known as Neptunists. The great apostle of Vulcanism in Britain was James Hutton (1788). He not only insisted upon the igneous nature of basalt rocks but demonstrated in the field that granite likewise was of igneous origin. This philosophical thinker deprecated the calling in of hypothetical causes to explain geological phenomena. The only agents of change, according to him, were those which are now at work in modifying the earth's crust. The past, therefore, was to be interpreted through the present. It was only through our knowledge of the methods employed by nature in carrying on her operations in our own day that we could hope to interpret the record of the rocks. The Huttonian theory was fortunate in having for its expounder John Playfair, whose famous *Illustrations* (1802) has long been held in the highest esteem, and is still studied by geologists. Another friend and disciple of Hutton, Sir J. Hall, became the founder of experimental geology, and did much towards the establishment of the cardinal doctrines of his teacher. Hutton's observations were confined to Scotland, in which fossiliferous strata are not prominently developed. It was the igneous masses —the crumpled and shattered rocks of mountain and glen and sea-coast, and the never-absent evidence of denudation and decay that fascinated him. He saw 'the ruins of an older world in the present structure of the globe,' but he knew nothing of that long succession of ruined worlds, each characterised by its own life-forms, with which William Smith (1790) was shortly to astonish geologists. This able investigator alone and unaided had explored all England on foot, and succeeded in completing a geological map of the country on which the strata were for the first time delineated and thrown into natural divisions. His views as to the law of superposition among strata were arrived at independently of Werner, and he was the first to point out how each rock-group was distinguished by its own peculiar fossils. Hence Smith is justly entitled to be called the founder of historical or stratigraphical geology. Since then the progress of geology has been rapid. Fossils which at first were valued chiefly as marks by which one formation could be distinguished from another by-and-by claimed fuller attention—the classic researches of Cuvier in the Paris basin forming a great epoch in Palæontology (q.v.), or the study of fossil organic remains.

In closing these remarks on the history of the geological sciences, it would be unjust to omit the name of Lyell, whose great *Principles of Geology* (1830-33) did invaluable service. His labours were based on those of Hutton and Playfair, but he carried out their doctrines further in some directions than either of these geologists were prepared to go, while in other directions he did not advance so far. Before the appearance of Lyell's well-known work, the Huttonian philosophy had conspicuously triumphed, but geologists were still prone to account for what appeared to be 'breaks in the succession' by the hypothesis of vast catastrophes. They conceived the possibility of world-wide destruction of floras and faunas, and the sudden introduction or creation of new forms of life, after the forces of nature had sunk into repose. The full meaning of denudation had not as yet been generally appreciated, and subterranean

action was still frequently appealed to in explanation of orographic features which are now recognised to be the work of epigene action. Such views gained for their upholders the name of Cataclysmists or Catastrophists. Lyell's main idea that the present is the type of all preceding ages, so far as these are revealed by the fossiliferous strata, has gained for his school the title of Uniformitarian. But within recent years many of his disciples have departed somewhat from the teaching of their master, and maintain that the operations of nature have been the same *in kind*, but not necessarily *in degree*. The impulse given to the advance of biological science by the publication of the *Origin of Species* (1859) has also affected geology, and not on its palæontological side alone. In the departments of physical and stratigraphical geology one may note a larger and broader method of treatment since the appearance of Darwin's famous work—the dominant tone in geological literature at present being rather evolutional than uniformitarian in the narrow sense. Another distinguishing feature of geological science in our day is the great attention paid to Petrography (q.v.), the study of which had fallen into comparative neglect in this country for many years. Interest in it, however, was revived by Dr Sorby, who showed how much might be learned by examining thin slices of rocks and minerals under the microscope. The introduction of the microscope into petrographical investigation has thus opened up a wide and novel field of inquiry, from the assiduous cultivation of which much may be expected.

It may be interesting to point out as shortly as possible the order of development of the geological sciences. Unquestionably the earliest to take shape was *Mineralogy*—a work on descriptive mineralogy by Agricola having appeared in 1546. In fact, several complete treatises had been published before the middle of the 18th century. *Geognosy*, or the study of the various rocks of which the earth's crust is composed without special reference to the mode of their arrangement, was the kind of geology which chiefly occupied the attention of the earliest investigators. The term is now practically disused, and in its place we have *Petrography*. When employed by modern writers it has usually a wider signification (see GEOGNOSY). *Structural Geology*, or the mode in which rocks are built up in the earth's crust, next began to come into prominence, and *Dynamical Geology*, or the study of causes now in action soon followed—the system advocated by Hutton and Playfair being that which has gained general acceptance. Thereafter followed *Experimental Geology*, of which Hall was the father. Although some progress had been made by Lehmann, Fuchsel, and Werner in the method of determining the succession of strata and of grouping these in chronological order, yet *Historical* or *Stratigraphical Geology* can hardly be said to have existed as a science before the date of William Smith's classical researches. *Palæontology* is of still more recent origin, the names of Cuvier, Lamarck, and Brongniart being conspicuous among its earliest exponents.

A brief outline may now be given of the various departments of geology, properly so called.

DYNAMICAL GEOLOGY.—The modern system of geology is based on the principle that the past is to be interpreted through the present. In other words, the geologist believes in the constancy of nature, and that by studying the effects produced by the action of her various agents in the present he will be able to interpret the records of such action in the past. The study of such natural operations constitutes *dynamical geology*.

The various forms of energy from which geological changes arise may be divided into two series—viz. *hypogene action* and *epigene action*.

Hypogene Action.—Under this head come the changes which are induced by the internal heat of the earth, those changes, namely, that are in progress beneath the earth's surface. In this category are included volcanoes and volcanic action, volcanic products, and the chemical and mechanical changes which are superinduced in such products and upon the rock-masses with which these come into contact during volcanic eruptions (see VOLCANOES). Lava (q.v.) and Tuff (q.v.) are studied as regards their composition, texture, and structure, while the manner in which these and other volcanic products are built up is likewise investigated. All this is done with a view to comparing such volcanic products with similar crystalline and fragmental rocks which occur in regions where volcanic action may have become quite extinct. Another most important set of hypogene phenomena are movements of the earth's crust. See EARTHQUAKES, UPHEAVAL, BEACHES (RAISED), SUBMARINE FORESTS.

Epigene action has reference to those operations that affect mainly the superficial portion of the earth's surface. The epigene agents are the atmosphere, rain, brooks and rivers, ice, the sea, and life. The effects of atmospheric action are seen in the general disintegration of rocks, the formation of Soil (q.v.), and the accumulation of dust and sand (see DRIFT). In the diffusion of life over the globe, wind has also no doubt played in all ages an important part. Rain, again, charged with the carbonic acid, &c., which it absorbs from the atmosphere and vegetable soil, acts chemically upon rocks—all of which are more or less permeable. Much rock-disintegration is thus induced, the 'weathered' materials being dispersed or accumulated locally by the mechanical action of the rain. The chemical action of rain is not confined to the surface of the ground, for much water filters down through natural cracks, fissures, &c., and is thus enabled to soak into the rocks at all depths. The underground water which is not absorbed in the interstitial pores of rocks rises eventually, and is discharged at the surface as Springs (q.v.), which are more or less impregnated with dissolved mineral matter abstracted from below. These springs are either cold or thermal, and constant or intermittent. In some volcanic regions the water comes to the surface in eruptive fountains (see GEYSERS). The destructive action of such underground waters is seen in the excavation of caves, tunnels, and other subterranean passages (see CAVES), and in the production of Landslips (q.v.) and rock-falls; while their reproductive action is familiarly illustrated by the formation of Stalactites and Stalagmites (q.v.), and the accumulation of great masses and sheets of siliceous Sinter and Calcareous Tufa (q.v.). Brooks and rivers act as potent agents of change. By means of the detritus which they sweep along or carry in suspension, they rub, grind, and erode the rocks over which they flow, and thus in time ravines and valleys have been excavated. The eroded materials are constantly travelling from higher to lower levels until they come to rest in lakes or the sea. Hence lakes and the sea in many places are being gradually silted up—the growth of Deltas (q.v.) being one of the most notable evidences of epigene action. The action of rain and running water is greatly aided by frost, which is a powerful disintegrator of rocks. Water freezes as well in the minute pores of rocks as in the fissures by which rocks are traversed, and thus when thaw ensues the loosened grains and particles are ready to be carried away by wind, rain, and melting snow; while disjointed blocks, &c. may fall asunder and topple from cliffs or roll down steep slopes. In regions of

perennial snow-fields the avalanche and the glacier likewise act as important denuders of the surface, and transporters of rock-debris from higher to lower levels (see AVALANCHES, GLACIERS, BOULDER-CLAY, &c.). Again, in certain latitudes lake and river ice are conspicuous agents of change—acting especially as rafts for the transport of stones and debris (see ANCHOR-ICE). Thus the whole surface of the land from the highest mountains down to the sea is being gradually degraded or lowered by the combined action of many epigene agents. There is a continual and universal disintegration of rocks going on, and a no less continual transport of material and building up of this into new formations. Alluvial flats and terraces, deltas, &c. may be cited as prominent examples of the sedimentary series of modern accumulations, while the chemical series is well represented by the calcareous formations of springs and brooks, and the precipitations of common salt, sulphate of lime, &c., which are taking place in saline lakes (see LAKES).

The sea as a geological agent acts in three ways: it erodes rocks, and transports and accumulates sediment. The work of erosion is confined for the most part to that marginal belt within which waves and breakers work. These by means of the shore-detritus batter and undermine cliffs, and cause them gradually to recede, and hence the sea may be said to act like a great horizontal saw. The materials brought down by rivers or detached from the shore by the action of the sea itself are distributed by currents over the sea-floor, the coarser detritus gathering in shallow water, while the finer sediment is swept out to greater depths and spread over wider areas. Such terrigenous materials extend outwards from the shore to a distance of 60 to 300 miles, and to depths of 2000 feet or more. They are confined, therefore, to a comparatively narrow belt of the sea-bottom. Over the abysmal depths of the sea, the only accumulations in progress are organic ooze and a peculiar red clay which is believed to be the result of the chemical action of sea-water on products of volcanic origin (see ABYSMAL ACCUMULATIONS). Now and again, stones and debris may be carried out to sea by icebergs and dropped beyond the zone of terrigenous sedimentation. Similarly, rock-fragments entangled in the roots of trees or buoyed up by seaweeds may now and again come to rest in abysmal regions. Reference has been made to the geological action of the ice of lakes and rivers, but the icebergs and ice-rafts of high latitudes must not be omitted. Much rock-debris is distributed by such agencies over the sea-bottom, detached fragments of the 'Ice-foot' (q.v.) being the most notable carriers of stones.

The action of plants and animals is not ignored by geologists. Plants aid in the disintegration and rupture of rocks by means of their roots and the organic acids derived from them during decay. Rocks are drilled and bored by some kinds of marine molluscs, annelids, echini, and sponges, and are thus weakened and more readily yield to the action of waves and breakers. Burrowing animals also bring about changes, the common earthworm being an efficacious agent in the formation of soil (see EARTHWORM). Plants occasionally act as conservative agents, as in the fixing of blown sands (see DUNES), and in protecting the banks of lakes and rivers. Again, forests, by equalising and regulating the flow of the water of precipitation, prevent the destruction of soils and subsoils by torrential action. In some regions also the rocks along a seashore are partially protected from the waves by seaweed, sponges, zoophytes, and gregarious molluscs. Amongst formations of organic origin may be mentioned soil (in part), peat-bogs, morasses, mangrove-swamps, bog-iron ore, &c. Some calcareous algæ also form considerable beds, as among the reefs of the Florida seas; while certain marsh-loving and fresh-water plants have the power of abstracting carbonate of lime from water and encrusting themselves therewith. Thick masses of calc-tufa have originated in this way. The organic oozes of the deep seas are good examples of deposits formed of the exuviæ of minute pelagic organisms; and the great coral-reefs (see CORAL) of the warmer oceans are still further evidence of the importance of life in the production of new formations. Such are some of the accumulations which are almost wholly composed of organic debris; but animals and plants contribute to the growth of many other deposits. The marine terrigenous formations are charged more or less abundantly with the relics of animal and plant life; nor are similar remains wanting in the alluvial deposits of rivers and lakes.

PETROLOGY.—From the study of causes now in action the geologist learns that many of the rocks, with which every one, whether observant or not, necessarily makes some acquaintance, are of the same character as epigene and hypogene products. For a particular account of the rocks themselves, PETROGRAPHY and the articles therein cited may be consulted; here all that can be attempted is to point out very briefly how far a knowledge of formations now in progress enables us to explain the nature and origin of rocks.

(1) *Igneous Rocks.*—In Great Britain and other countries where at present there is no volcanic action we meet with various glassy rocks, such as pitchstone and obsidian, with semi-crystalline rocks, as trachyte, phonolite, liparite, andesite, basalt, &c., with crystalline rocks, such as certain dolerites, and with fragmental rocks, like tuff and agglomerate, which in every essential particular resemble the products of modern volcanoes. But, as might have been expected, the older igneous rocks are often more or less altered, such alteration having been superinduced by the chemical action of percolating waters, by pressure, by crushing, or by these and other causes combined. There is a class of crystalline rocks, however, which, although they consist of the same mineral ingredients as occur in many igneous rocks, yet differ so materially in character from lavas that geologists are warranted in believing that they could not have been consolidated at or near the surface of the earth. This class is represented by such rocks as granite, syenite, gabbro, and certain diorites, dolerites, quartz-porphyries, &c. A study of these rocks under the microscope and in the field as rock-masses leads to the belief that they are indeed of igneous origin, but have cooled and consolidated at some depth in the earth's crust, their appearance at the surface being due to subsequent denudation. Thus two classes of igneous rocks are recognised—viz. *volcanic* or superficial, and *plutonic* or deep-seated.

(2) *Derivative Rocks.*—Under this head are included all the products of epigene action. They are termed *derivative* inasmuch as most of them are composed of materials which have been derived from pre-existing rocks by the chemical or mechanical action of epigene agents, while others are made up of organic debris. They may be roughly classified as follows:

Mechanically-formed Rocks.—These consist of fragmental materials. They are granular non-crystalline aggregates, the constituent ingredients of which may be angular or rounded in form, and may or may not be arranged in layers. They consist of (*a*) *Eolian* or *Aerial* rocks, such as blown sand (dunes) and dust-deposits. The products of the 'weathering' action of the atmosphere, such as rock-debris (breccia), certain clays, &c., are also in part of eolian origin. (*b*) *Sedimentary* rocks,

as conglomerate, breccia (in part), sandstone, graywacke, various clays, mudstones, shales, &c. (*c*) *Glacial* rocks, as rock-debris, erratics, moraines, boulder-clay, &c.

Chemically-formed Rocks.—The rocks included under this subdivision are sometimes earthy in character, but more frequently show a crystalline or compact sub-crystalline texture. Among the more typical kinds are kaolin and various other clays, stalactites and stalagmites, calc-tufa and its varieties, geyserite (siliceous sinter), rock-salt, dolomite, gypsum, flint, chert, various ironstones, &c.

Organically-derived rocks are made up of the relics of animal and plant life. They include a great variety of limestones, diatom-earth (tripoli), flint (in part), various phosphatic deposits, peat, lignite, coal, anthracite, oil-shale, various iron ores, &c.

No hard and fast line can be drawn between the older and younger products of epigene action. It is obvious that conglomerate and sandstone are merely compacted gravel and sand; breccia is only consolidated rock-debris; while lignite and coal are simply vegetable matter more or less mineralised. The thick fossiliferous limestones of the earth's crust are paralleled by the coral-reefs and organic oozes of existing oceans, and have evidently had a similar origin. Every derivative rock, indeed, can be compared with a like product of modern epigene action. The older products, it is true, are most frequently solidified, while the younger are oftener more or less incoherent and unconsolidated. But this difference is not essential, and is only what might have been expected. The older products have for a long time been exposed to the action of percolating water. In many cases they have been subjected to the influence of subterranean heat and enormous pressure, and we need not wonder, therefore, that they should have acquired a more or less indurated character. But solidification does not invariably characterise the older products, nor are modern accumulations always incoherent. There are indurated conglomerates and sandstones of very recent formation, and some modern coral-rock is as hard and compact as the older limestones. Hence the term *rock* is applied to all the products of epigene and hypogene action alike, whether the material so designated be yielding, as clay and peat and blowing sand, or hard and resisting, as conglomerate, limestone, or granite.

(3) *Metamorphic Rocks.*—All rocks sooner or later undergo some process of alteration whereby their original character becomes modified. Thus, by the chemical action of percolating water some limestones have been more or less changed into dolomite; olivine rocks have been altered into serpentine; some sandstones have been converted into quartzites. Derivative rocks at the point of contact with igneous rocks are very frequently altered to a greater or less extent. Thus, ordinary limestone becomes crystalline marble, coal is changed into graphite, sandstone into quartzite, clay and shale into porcellanite. When alteration of a rock, however caused, has proceeded so far as to produce a rearrangement of the constituent elements of a rock, and to develop a crystalline or semicrystalline structure, such extreme alteration is termed *metamorphism*, and the rocks so affected are described as *metamorphic*. Rocks of this kind are sometimes confusedly crystalline or massive in structure, and in hand specimens might be mistaken for plutonic igneous rocks; but by far the larger number are distinguished by a peculiar flaky or pseudo-laminated structure which is termed *Foliation* (q.v.). In foliated or schistose rocks the constituent minerals are arranged in alternate lenticular layers which merge into each other. Such arrangement, it must be understood, has no relation to the layers of deposition so frequently present in derivative rocks like shale, sandstone, &c. The foliated structure has been superinduced in rocks, some of which may have been igneous and others aqueous in origin. It is obvious, however, that the study of causes now in action can throw little light on the origin of foliation. We may study the changes induced in rocks by contact with the products of modern volcanic action, and these will doubtless enable us to understand how certain alterations in rocks have been brought about; but schistosity is not superinduced in rocks in the neighbourhood of modern volcanic orifices. In Britain and other countries, however, denudation has exposed the interior and basal portions of ancient volcanoes, and we can now study in detail the fractured and baked rocks through which heated gases, molten matter, &c. have been erupted. Nay, in some cases, we can even examine enormous masses of plutonic crystalline rock which are believed to be the reservoirs from which the molten matter of our ancient volcanoes was pumped to the surface. Such great plutonic masses are frequently surrounded by a zone or belt of crystalline schistose rocks, such as gneiss, mica-schist, &c. The rocks are most crystalline and schistose in the immediate proximity of the igneous mass, but gradually lose these characters as they recede from its neighbourhood, until by-and-by they pass into ordinary derivative rocks such as graywacke, shale, &c. Some schistose rocks, therefore, undoubtedly owe their origin to contact with deep-seated igneous masses. Again, it has been observed that where rocks, whether igneous or derivative, have been subjected to enormous crushing and pressure, they not infrequently become crystalline and schistose. There are some schistose rocks, however, the origin of which is still very obscure. Geologists cannot yet assert, therefore, that all schistose rocks are metamorphic (see ARCHÆAN SYSTEM). Among the most characteristic metamorphic rocks are quartzite, marble, phillite, mica-schist, talc-schist, chlorite-schist, hornblende-schist, actinolite-schist, gneiss, granulite, eclogite, &c.

STRUCTURAL or GEOTECTONIC GEOLOGY is that branch of the science that deals with the arrangement or structure of rock-masses.

Structure of Igneous Rocks.—Igneous rocks are grouped under two series—viz. (*a*) *Contemporaneous* and (*b*) *Intrusive* eruptive rocks.

(*a*) *Contemporaneous eruptive rocks* are either crystalline or fragmental. The crystalline rocks are simply old lava-flows, while the fragmental rocks consist of tuff and its varieties. They are in short the products of volcanic action, and have been erupted at the earth's surface, accumulating either upon the land or under water. Many of these rocks have apparently been erupted from vents of the ordinary modern type, but others appear to have come up along lines of fissure in the earth's crust—the lavas overflowing the surface in broad floods. Successive outflows of this kind, accompanied frequently by the ejection of fragmental materials, have built up some great plateaus. Contemporaneous lavas are generally more or less scoriaceous or porous above and below.

(*b*) *Intrusive eruptive rocks* are also crystalline and fragmental. *Necks* are approximately cylindrical funnels filled with either crystalline igneous rock c[illegible] with both. They are obvio[illegible] of old volcanoes, the upper parts of which have been removed by denudation. *Intrusive Sheets* are more or less lenticular masses of crystalline igneous rock which have been erupted amongst strata in a direction more or less closely conformable with the planes of bedding. They seldom show any scoriaceous structure, and

generally bake and alter overlying as well as underlying rocks—thus clearly indicating their subsequent origin. *Dykes* (q.v.) consist generally of crystalline rock which has been erupted in approximately vertical and even-sided fissures, thus giving rise to wall-like intrusions. Occasionally fragmental igneous rocks, such as agglomerate, are met with in similar positions. *Veins* is the term applied to smaller irregular and more or less tortuous intrusions of crystalline rock. *Bosses* (see NECKS) are amorphous masses of crystalline rock, rising more or less vertically through surrounding rock-masses. There is reason to believe that many of these 'bosses' are the deep-seated reservoirs from which volcanoes were supplied with lava. 'Dykes,' 'veins,' and sometimes 'sheets' proceed from them into the adjacent rocks, which are often much altered and metamorphosed.

Structure of Derivative Rocks.—The most characteristic feature of these rocks is their bedding or stratification—a structure which is due to the mode of their accumulation. Hence they are often spoken of as the 'stratified rocks.' But, as we have seen, stratification likewise characterises contemporaneous eruptive rocks. As far the larger number of derivative rocks are simply aqueous mechanical and chemical sediments, they are also often termed 'aqueous' and 'sedimentary rocks.' Individual beds in a group of strata are lenticular or wedge-shaped; so that when any particular stratum is followed in one direction it eventually thins away and dies out. And the same is the case with groups of strata. Fine-grained deposits such as shale and limestone tend to be more persistent and to cover wider areas than sandstones and conglomerates. Almost any diversity of strata may occur in a group or series, but it is more usual to find certain kinds of rock associated together; thus, fine sandstone alternates with shale, conglomerate with grit, limestone with fine shales, &c. Again, individual beds are often found to change their character as they are followed in certain directions. Conglomerate, for example, passes laterally into sandstone, sandstone becomes argillaceous and passes into shale, while shale, by the gradual increase of calcareous matter, becomes marly and often passes into limestone. Sometimes the stratification is extremely regular, at other times the beds thicken and thin out very irregularly, and not infrequently they show what is called *false-bedding* or *current-bedding*—a structure which is seen both in aqueous and eolian accumulations (see DUNES). Amongst the surface-markings seen in sedimentary rocks the most common are ripple-marks, sun-cracks, rain-prints, and tracks, trails, burrows, &c. of worms, crustaceans, molluscs, reptiles, birds, &c.

Strata are not often quite horizontal; they usually *dip* at a less or greater angle, and such inclined strata are as a rule the remaining portions of large curves or undulations, the upper portions of which have been removed by denudation, so that the truncated strata crop out at the surface (see OUTCROP, STRIKE). The simplest form of curve assumed by strata is a Monocline (q.v.), but anticlinal and synclinal folds occur much more frequently (see ANTICLINE). In strata with a moderate dip the strata on opposite sides of an anticlinal axis incline at approximately the same angle. But in more steeply inclined beds the dip is often greater on one side than the other, the beds on the steeper side of the fold becoming doubled in below their equivalents on the other side. This is what is termed 'Inversion'—a structure which when repeated gives us what are called 'Isoclinal Folds' (see MOUNTAINS). In regions of highly folded strata the fossils and even the stones in conglomerates are often flattened and squeezed out of shape. Such *deformation* likewise characterises whole rock-masses, as is well seen in the structure termed Slaty Cleavage (q.v.). As an extreme result of enormous pressure we occasionally find that clastic rocks have been converted into crystalline schists.

Most rocks, as well igneous as derivative, become gradually more and more consolidated. Soft incoherent sands and clays are compressed; lavas cool and harden. All rocks therefore tend to contract, and in doing so they become cracked, regularly or irregularly as the case may be. During the process of folding they have likewise yielded to stress and strain by cracking across. Such cracks are termed Joints (q.v.). But rocks are not only jointed; frequently they are traversed by great fissures of displacement called Faults or Dislocations (q.v.), which may sometimes be traced across the whole breadth of a country. That the phenomena of folding, fracturing, and displacement are the result of earth-movements cannot be doubted, and there is abundant evidence to show that such disturbances have taken place again and again, sometimes over limited regions, at other times over very much wider areas. This is proved by the phenomena of Unconformity (q.v.), in which one set of beds rests on the upturned and denuded ends of an older series.

The fissures and cavities of rocks are in some places filled up again by the introduction of various kinds of mineral matter through the chemical action of percolating water. In many cases such mineral deposition may have taken place from heated solutions, under great pressure, and at great depths from the surface. This is probably the origin of many of the Ore-deposits (q.v.) met with as lodes or veins.

PALÆONTOLOGICAL GEOLOGY.—A study of the physical characters of rocks enables the geologist to arrive at many interesting conclusions as to the mode in which rocks have originated. By such evidence alone it is sometimes possible to discover the successive changes which some particular region has undergone. Thus, the phenomena of igneous and glacial accumulations tell their own story, and even in the case of many sedimentary deposits geologists are able, without the aid of fossils, to distinguish between deep-sea and shallow-water strata; while certain rock-structures, such as unconformity, yield him evidence of changing physical conditions. Without fossils, however, investigations into the successive phases through which the earth's surface has passed could not proceed far: historical geology would be impossible. It is chiefly by means of Fossils (q.v.) that the deep-sea or shallow-water origin and the marine or fresh-water character of strata are determined, and the climatic conditions under which they were deposited are ascertained. When we learn that many fossils belong to extinct species and even genera, and that different groups of fossils occur in different series of strata, it might seem, at first, as if this would tend rather to confuse than aid the geologist. But the cause of such apparent discrepancies lies, of course, in the simple fact that the fossiliferous strata belong to different ages—some are much older than others. In the uppermost or youngest series the organic remains approach most nearly to the life-forms of the present day, while in the lower and therefore older strata the fossils recede farther and farther from existing types as we follow them to lower and lower geological horizons. From this it would appear that there has been a gradual coming-in and dying-out of species, and observation has shown that when a particular flora or fauna has died out it never reappears in younger strata. When William Smith discovered that each well-marked group of strata was charac-

terised by its own suite of fossils he had got the key to the history of a long succession of geological changes; for the fossils enabled him to recognise each group in whatever part of the country it occurred, and however much its petrographical character might have changed. If three conformable series of strata occur in the order A, B, C—B superimposed on A, and C upon B, that order is never reversed elsewhere. Each term of the series may not always be present—either one or more may be absent—but those that do occur always occupy the same relative position. In such a conformable sequence each group may contain fossils peculiar to itself, but a larger or smaller number will usually be found to range from one group to another, or even from top to bottom of the whole. The fossils will, in short, indicate a gradual change of fauna and flora, as we pass from below upwards—old forms disappearing, new forms appearing. But should the middle term of the series (group B) be wanting, then the passage from A to C, owing to the absence of the connecting forms belonging to B, will be more or less abrupt. A conformable sequence, like A, B, C, points to the persistence of similar physical conditions during a longer or shorter period. If the fossils in each group indicate a sea of moderate depth while the stratum attains a thickness of several thousand feet, the inference will be that sedimentation has taken place during a slow movement of subsidence. In other words, the silting-up of the sea has been retarded by the gradual sinking-down of its bottom. On the supposition that the accumulation of the strata has been a very protracted process, the marine fauna will have undergone more or less modification. Such change in the life-forms, however, will probably have been very gradual; some species remaining longer unmodified than others, while a few may persist unchanged through the whole period of sedimentation. In the case of an unconformable sequence—where C rests directly on A, the physical conditions have evidently not remained constant. After the deposition of A, a movement of upheaval has ensued; the sea has disappeared and land has taken its place. Should land-conditions have continued for a very prolonged period before subsidence supervened and the area once more became submerged, the marine fauna will, in the meantime, have undergone more or less modification in those regions to which it migrated while elevation was in progress. Thus the sediment (group C) which subsequently accumulated over the drowned land-surface would come to contain a suite of organic remains that might differ greatly from those occurring in the immediately subjacent group A. And the longer the interval between A and C, the more strongly marked would be the break in the succession of life-forms. Such 'breaks in the succession' are of common occurrence—local and more widely-spread movements of depression and elevation having characterised the formation of the fossiliferous strata everywhere. When it is remembered that every bed of aqueous rock has been formed out of the ruins of pre-existing rocks, igneous or derivative, or both, it is obvious that the fossiliferous strata cannot possibly contain a perfect record of all the forms of life which may originally have been entombed in sediment. Many fossils must have disappeared along with the rocks which contained them. Thus, in the case of such a 'break in succession' as that just described, it is obvious that the strata of group A would be more or less denuded before group C began to be accumulated—C would rest unconformably upon A. Nor can we believe that the life-forms of earlier ages were ever more fully represented by fossils than existing faunas and floras will be by the remains of living things which are now being buried in sediment. Of the myriads of existing terrestrial plants and animals how few will leave any relic behind them! Aquatic, and more especially marine forms, will doubtless be preserved in far greater variety and abundance; but amongst these are many delicately-fashioned and soft-bodied creatures which can only become fossils by accident, as it were. Such considerations as these should lead us to expect that the fossiliferous strata, even when these have apparently been accumulated in a continuous manner, will contain a most imperfect record of the past life-history of the globe. But notwithstanding this imperfection of the geological record there is yet ample evidence to show that gradual extinction of old and evolution of new faunas and floras has been the rule. Life has been persistent from its introduction, but subject to endless modifications. With this continuity in geological history it is obvious that any subdivisions of past time that we choose to make must be arbitrary, for the germ, as it were, of one so-called period must have begun in the period that preceded. But, just as in human history it is convenient to use such terms as the 'Middle Ages,' the 'Elizabethan Period,' &c., so in geology it is useful and indeed necessary, for purposes of description and correlation, to group the records into so many subordinate divisions. 'Unconformities,' 'breaks in succession,' &c. often enable this to be done with more or less ease; but in the case of the better-preserved portions of the stony record it is often very hard to say where a division-line should be drawn.

HISTORICAL GEOLOGY.—The forms of life that existed during some prolonged period of the past have a certain *facies* which serves to distinguish them as a group from the living things that flourished in preceding and succeeding ages. And the strata which contain such a well-marked assemblage of fossils are included under the term *System*. By this term, then, is understood all the deposits, whether terrestrial, fresh-water, or marine, which accumulated over the earth's surface upon land, in lakes, or in the sea, at a time when the world was characterised by the presence of some particular and peculiar fauna and flora. By comparing and correlating the fossiliferous strata throughout the world geologists have been able to arrange the various systems in chronological order. The following table shows the larger divisions and subdivisions in the order in which they would appear if they all occurred in one and the same section. (Each system will be found described under its own title.)

4. QUATERNARY OR POST-TERTIARY.	Recent System. Pleistocene "
3. TERTIARY OR CAINOZOIC.	Pliocene " Miocene " Oligocene " Eocene "
2. SECONDARY OR MESOZOIC.	Cretaceous " Jurassic " Triassic "
1. PRIMARY OR PALÆOZOIC.	Permian " Carboniferous System. Old Red Sandstone and Devonian System. Silurian System. Cambrian " Archæan "

PHYSIOGRAPHICAL GEOLOGY.—Under this head is discussed the origin of the surface-features of the land—mountains, valleys, &c. The study of causes now in action shows that everywhere rocks are undergoing disintegration, the resulting detritus gradually travelling from higher to lower levels until eventually it reaches the sea. This continuous and universal denudation is easily read in the present appearance of the rocks forming the surface of the land. The phenomena of truncated strata, faults, &c. (see DENUDATION) demonstrate

that thousands of feet of rock have been gradually removed in the form of detritus. To appreciate this fact some knowledge of structural geology is necessary. In regions which have long been exposed to denudation we recognise a very remarkable connection between the configuration of the ground and the nature and mode of arrangement of the rocks. The valleys and low grounds, for example, coincide in a general way with the distribution of the less durable rocks, while escarpments, hills, and ridges mark out the sites of the more resisting rock-masses. Again, in the case of undulating and folded strata, it most frequently happens that anticlines instead of forming hills give rise to valleys, while synclines correspond as a rule not to valleys but to hills. The reasons are obvious, for relatively hard rocks resist denudation better than softer rocks; and, while an anticlinal arrangement and the jointing of strata favour the action of the denuding agents, in the case of synclinal strata the rock-structure has just the opposite effect (see LANDSLIPS, MOUNTAINS). Thus the features impressed upon the land by denudation depend partly upon the composition and texture of the rocks, and partly upon their structure as rock-masses. In the case of a true mountain-range of recent elevation the larger features of the surface correspond in a general way with the folds of the strata. Thus the mountain-ridges often run in the direction of great anticlinal axes, while the long parallel valleys coincide with synclinal axes (see ALPS). But even in the case of mountains of elevation denudation has often profoundly modified such features. Anticlinal mountains are very unstable; rock-falls and landslips from time to time take place; and the tendency is for all mountains of that character to become effaced. Sooner or later the orographical features change, and are eventually determined by the epigene agents, directed and controlled by the composition and structure of the various rock-masses. Geologists recognise three kinds of mountains: (1) *Mountains of Accumulation*, such as volcanoes; (2) *Mountains of Upheaval*, such as true mountain-ranges like the Alps; and (3) *Mountains of Circumdenudation*, which owe their origin to the removal of material that formerly surrounded them, such as the mountains of the British Islands.

A *plateau* or tableland is simply an elevated plain, and may consist either of approximately horizontal sheets of rock, like the plateau of the Colorado, or of more or less highly folded and even contorted strata, which have been planed down to one general level, like the plateaus of Scandinavia and the Scottish Highlands. Both kinds of tableland are usually traversed by valleys, which have been excavated by running water, and sometimes, as in the case of the Scottish Highlands, they are so highly denuded that their plateau-character becomes obscure. Plateaus owe their elevation to upheaval, those which are built up of horizontal strata being termed *plateaus of accumulation*, while those which consist of folded and contorted strata are known as *plateaus of denudation*. *Plains* are only less elevated plateaus. Some of these, as, for example, the wide alluvial plains and deltas of great rivers, owe their origin to accumulation. Others, again, consist of low-lying land, the level of which has been reduced during a protracted period of denudation. Should such an area eventually be elevated it would become a plateau of denudation.

SPECULATIVE GEOLOGY.—There are certain great physical problems the data for solving which are more or less incomplete, or in the very nature of things beyond our knowledge. Amongst such is the question of the *age of the sun's heat*. This, of course, is rather a physical than a geological question, and yet geology furnishes evidence on the subject which the physicist cannot ignore. Some physicists are of opinion that the sun's heat is due to gravitation—that, as Sir W. Thomson remarks, the sun's matter, before it came together and became hot, may have existed in the condition of two cool solid bodies which collided with the velocity due to their mutual gravitation. If gravitation, therefore, be the only source of the sun's heat, that luminary cannot have been giving out heat at the present rate of radiation for a longer period than 20,000,000 years, or, as Professor Tait maintains, 10,000,000 years. But no geologist will admit that all the changes that have taken place on the earth's surface since the first appearance of life can possibly be included within such narrow limits. According to Dr Croll, however, the sun probably originated from the collision of two bodies moving directly towards each other with velocities greater than the velocities due to their mutual gravitation. As the heat generated by the impact of two such bodies would depend upon the velocity possessed by each before collision took place, it is obvious that the energy stored up in our sun may be infinitely greater than that which could have been derived from gravitation alone. So far, therefore, as a possible source of the sun's energy is concerned, Dr Croll is of opinion that life might quite well have begun 100,000,000 years ago.

Condition of the Earth's Interior.—This is another physical problem in the solution of which geology is necessarily interested. Several views have been advanced by physicists, the more generally received opinion being that the earth is a more or less solid globe. Others favour the hypothesis of a thin crust enclosing a liquid or viscous interior; while yet others think that a liquid substratum separates the crust from a solid nucleus. The appearance of volcanoes and thermal springs shows us that a high temperature exists beneath the crust, and similar evidence of internal heat is furnished by borings and mines. The mean of many observations shows that temperature increases 1° F. for every 54 feet of descent, so that if the temperature at the surface be 50°, the boiling-point of water (212°) will be reached at the depth of about a mile and a half. It is evident, therefore, that at a comparatively short distance from the surface the heat would be sufficient (at atmospheric pressure) to melt all kinds of mineral matter with which we are acquainted. It is supposed, however, by those who maintain that the earth is solid throughout, that the substance of the earth's interior is kept from liquefying by pressure. So far as geological facts go they are opposed to the view of a solid globe or of an enormously thick crust. The folding and contortion of strata seem to imply the presence of an underlying yielding mass upon which the solid crust may have a certain freedom to move during the shrinking and contraction that must result from the secular cooling of the earth (see EARTH, MOUNTAINS).

The *origin of volcanic action* has also been a much-canvassed question, and is variously explained according as the hypothesis of a solid or of a viscous interior is held to be the more probable (see VOLCANOES). Closely connected with such problems is that of the *origin of oceanic basins and continental areas*. Of late years the belief has gained ground that these dominant features of the earth's surface are of primeval antiquity—that in their origin they antedate the oldest of the sedimentary formations. It is a remarkable fact that hitherto, amongst the various formations that enter into the composition of the land of the globe, no trace of any abysmal accumulations has been met with. On the contrary, the aqueous rocks appear to have been deposited as a rule in relatively shallow seas. Many oscillations of level have taken place at successive periods within each continental area, by which the extent and outline

of the land have been again and again modified, but the great continental ridges, according to the geological evidence, would appear to have persisted from the earliest times as dominant elevations of the earth's crust. 'The continents,' as Professor Dana remarks, 'have never changed places with the oceans.' See ABYSMAL ACCUMULATIONS.

Changes of Climate.—The geological record everywhere bears testimony to the fact that the climate of the globe has from time to time undergone changes. In our day climate is differentiated into zones; there is a marked change in the temperature as we pass from the equator to the poles. Latitude, and the relative positions of the great land and water areas, are doubtless the chief factors in the determination of the present climates of the globe, and must have had a similar influence on the climate of much older periods. Sir Charles Lyell and others have held, therefore, that such climatic vicissitudes as we have evidence of in the fossiliferous strata were probably induced by changes in the distribution of land and sea. Others have doubted whether this will explain the facts. If it be true that the great continental ridges are of primeval antiquity, then continents and seas could not have changed places, as Lyell supposed. The climatic conditions of the Glacial Period (q.v.) cannot possibly be due to such revolutions, for the distribution of land and sea during Pleistocene times was practically the same as at present. Stated briefly, the facts of geological climate are these: In Palæozoic ages the climate would appear to have been singularly genial and uniform over the globe. All through Mesozoic times similar genial conditions seem to have extended from what are now temperate up to polar regions. But the evidence indicates apparently that the climate of the latter was somewhat less genial than that of more southern latitudes. In Cainozoic ages, likewise, the climate continued to be mild even in high Arctic lands, but towards the close of the Tertiary era a general lowering of the temperature took place. Thereafter followed the Quaternary period with its extraordinary climatic changes (see GLACIAL PERIOD, PLEISTOCENE SYSTEM). It is possible, as some suppose, that the uniform climates of the earlier geological periods may have been due in part to the former greater heat of the earth. But probably the chief factor was the peculiar disposition of land and water. The continental areas appear for long ages to have been represented by groups of larger and smaller islands—a condition of things which would allow of the more or less free circulation of oceanic currents round the world. Under such conditions atmospheric temperature and pressure would have a very different distribution from the present. It can hardly be doubted, also, that cosmical causes must have had some influence upon former climates. Dr Croll believes that the strongly contrasted climates of the Pleistocene period (glacial and interglacial epochs) were the indirect result of increased eccentricity of the earth's orbit combined with the precession of the equinox. It has been objected to this theory that we have no evidence in the older geological periods of such remarkable climatic changes, which, if the theory be true, ought to have happened again and again during preceding periods of high eccentricity of the orbit. We are not, however, without evidence of ice-action in Palæozoic, Mesozoic, and Cainozoic times. The evidence is not abundant, but, considering the conditions of sedimentation, it is perhaps as much as could have been expected. It is doubtful, however, whether the arrangement of land and water in our hemisphere at any period anterior to later Cainozoic times could have favoured such enormous accumulations of snow and ice as those of the Pleistocene. When the continents were represented by groups of islands, the conditions for the massing of such great icefields could not have existed. And, if it be true that the climate of the globe in the earliest geological ages was influenced by the greater internal heat of the earth, the effects flowing from great eccentricity of the orbit might often be modified or neutralised.

Among the many subjects connected with geology which have separate articles assigned to them in this work, not to speak of the sections on the geology of Europe, Asia, Africa, America, Australia, and the several countries, are the following:

Abysmal Accumulations.	Metamorphism.
Archæan System.	Mineralogy.
Artesian Wells.	Miocene System.
Ásar.	Mountains.
Boulder-clay.	Necks, Volcanic.
Cambrian System.	Old Red Sandstone.
Carboniferous System.	Oligocene System.
Caves.	Ore Deposits.
Coal.	Palæontology.
Coral Islands.	Peat.
Cretaceous System.	Permian System.
Denudation.	Petrography.
Dislocations.	Pleistocene System.
Drift.	Pliocene System.
Earthquakes.	Recent System.
Eocene System.	Silurian System.
Fossils.	Springs.
Glacial Period.	Strata.
Joints.	Triassic System.
Jurassic System.	Unconformity.
Lakes.	Upheaval and Depression.
Landslips.	Volcanoes.

See, for General Geology, Lyell's *Principles of Geology* (1876); De la Beche's *Geological Observer* (1853); Lyell's *Elements of Geology* (1865); A. Geikie's *Text-book of Geology* (1887); Prestwich's *Geology* (2 vols. 1886-88); Phillips' *Geology*, edited by Etheridge and Seeley (2 vols. 1885); Green's *Physical Geology* (1882). The following are less elaborate treatises: Lyell's *Student's Elements of Geology* (1885); A. Geikie's *Class-book of Geology* (1886); J. Geikie's *Outlines of Geology* (1888); Jukes-Brown's *Handbook of Geology* (2 vols. 1884-86); Page and Lapworth, *Introductory Text-book of Geology* (1888). Of American and continental text-books may be mentioned: Dana's *Manual of Geology* (1875); Le Conte's *Compend of Geology* (1884); Credner's *Elemente der Geologie* (1887); Naumann's *Lehrbuch der Geognosie* (3 vols. 1858-72); *Allgemeine Erdkunde*, by Hann, Von Hochstetter, and Pokorny (1881); De Lapparent's *Traité de Géologie* (1884); Stoppani's *Corso di Geologia* (1871). Hutton's *Theory of the Earth* (1795) is interesting as containing [illegible] of geology. See also [illegible] *an Theory* (1822). [illegible] of geology the following may be cited: For Cosmical Aspects of Geology, see Sir W. Thomson, 'On the Age of the Sun's Heat,' in *Popular Lectures and Addresses* (vol. i. 1889); Croll's *Climate and Time* (1875), *Climate and Cosmology* (1885), and *Stellar Evolution* (1889). For Petrographical Geology, see references under PETROGRAPHY. For Dynamical Geology, see Darwin's *Geological Observations on Volcanic Islands* (1884), and *Observations on South America* (1846; both works in 1 vol. 1876); Scrope's *Volcanoes of Central France* (1858), and *Volcanoes* (1872); Judd's *Volcanoes* (1881); R. and J. W. Mallet's *Earthquake Catalogue* (1858); Milne's *Earthquakes* (1886); Fuchs's *Vulcane und Erdbeben* (1875); Fouché's *Les Tremblements de Terre* (1888); Twelfth Annual Report of U.S. Geological and Geographical Survey of the Territories (1883; for Geysers); Fisher's *Physics of the Earth's Crust* (1882) (works referred to at MOUNTAINS); Bischoff's *Chemical and Physical Geology* (1854-59), and the Supplement (in German, 1871); Roth's *Allgemeine und chemische Geologie* (1879); Agassiz' *Études sur les Glaciers* (1840); Forbes's *Travels through the Alps* (1843), and *Occasional Papers on the Theory of Glaciers* (1849); Tyndall, *The Glaciers of the Alps* (1857); Darwin's *Vegetable Mould and Earthworms* (1881), and *Coral Reefs* (1874); Dana's *Corals and Coral Islands* (1875). Further references to special works dealing with dynamical geology will be found in the larger text-books of geology; see also article METAMORPHISM. For Structural or Geotectonic Geology,

consult the standard text-books of geology; see also article STRATA. For Experimental Geology, see Daubrée's *Études Synthetiques de Géologie Expérimentale* (1879). For works dealing with Palæontology, see under that article. For Physiographical Geology, see Memoirs of [illegible] of British Islands, *passim*; Ramsay's *Geology of Great Britain* (1878); A. Geikie's *Scenery and Geology of Scotland* (1889); Hull's *Physical Geography and Geology of Ireland* (1878); Dutton's 'Tertiary History of the Grand Cañon District,' *Monographs of U.S. Geol. Survey* (vol. ii. 1882); also Annual Reports of U.S. Geol. and Geograph. Survey of Territories (1867-78), *passim*; De la Noë and De Margerie, *Les Formes du Terrain* (1888). For Geology of British Islands, see Maps and Memoirs of the Geological Survey; works by Ramsay, A. Geikie, and Hull already cited; Woodward's *Geology of England and Wales* (1887); Kinahan's *Geology of Ireland* (1878); Murchison's *Siluria* (1867); Macculloch's *Western Islands of Scotland* (1819); Nicol's *Guide to the Geology of Scotland* (1844) —these last two works rather out of date; Miller's *Old Red Sandstone* (1858); Green, Miall, and others, *Coal: its History and Uses* (1878); Hull's *Coalfields of Great Britain* (1881); Meade's *Coal and Iron Industries of the United Kingdom* (1882); Phillips' *Geology of Oxford and the Valley of the Thames* (1871), and *Geology of the Yorkshire Coast* (1875); Tate and Blake, *The Yorkshire Lias* (1876). For further references to treatises dealing with the geology of England and Wales, see especially Woodward's work cited above. The following works deal with Pleistocene Geology and the Antiquity of Man: Lyell's *Antiquity of Man* (1873); Lubbock's *Prehistoric Times* (1878); Evans' *Ancient Stone Implements of Great Britain* (1872); Dawkins' *Cave-hunting* (1874), and *Early Man in Britain* (1880); J. Geikie's *Great Ice Age* (1877), and *Prehistoric Europe* (1881); Dawson, *The Earth and Man* (1887); De Quatrefages, *The Human Species* (1879); Joly's *Man before Metals* (1883); Penck's *Die Vergletscherung der deutschen Alpen* (1882); Falsan, *La Période Glaciaire* (1889); Wright's *Ice Age in North America*, &c. (1889). For treatises bearing on Geological Climate, see Croll's works already cited; also J. D. Whitney, *The Climatic Changes of Later Geological Times* (1882). Amongst works on Economic Geology the following may be mentioned: Page's *Economic Geology* (1874); Williams' *Applied Geology* (1886); Penning's *Engineering Geology* (1880); Nivoit's *Géologie appliquée à l'Art de l'Ingénieur* (1887). The larger text-books usually contain remarks on the method of geological observation and the construction of geological maps. This subject is dealt with more fully in A. Geikie's *Outlines of Field Geology* (1879), and Penning's *Field Geology* (1876).

Geomancy. See DIVINATION.

Geometrical Mean of two numbers is that number the square of which is equal to the product of the two numbers; thus, the geometrical mean of 9 and 16 is 12, for $9 \times 16 = 144 = 12^2$. Hence the geometrical mean of two numbers is found by multiplying the two numbers together, and extracting the square root of the product.

Geometrical Progression. A series of quantities is said to be in geometrical progression when the ratio of each term to the preceding is the same for all the terms—i.e. when any term is equal to the product of the preceding term and a factor which is the same throughout the series. This constant ratio or factor is termed the *common ratio*. For example, the numbers 2, 4, 8, 16, &c., and also the terms a, ar, ar^2, ar^3, &c., are both examples of geometrical progression or series. The sum of such a series is obtained as follows: Let a be the first term, n the number of the terms whose sum, s, is required, and let r be the common ratio. Then $s = a + ar + ar^2 + \ldots + ar^{n-1}$; also from multiplication of both sides of this equation by r, $sr = ar + ar^2 + ar^3 + \ldots + ar^n$. Subtraction of the former from the latter expression gives $sr - s = ar^n - a$; or $s(r-1) = a(r^n - 1)$, and hence $s = \frac{a(r^n - 1)}{r - 1}$.

Geometry is that branch of the science of mathematics which treats of the properties of space. When the properties investigated relate to figures described or supposed to be described on space of two dimensions, there arise such subdivisions as plane and spherical geometry, according to the surface on which the figures are drawn. If the properties relate to figures in space of three dimensions they fall under what is called solid geometry, or now more frequently, geometry of three dimensions. Again, from the mode in which the properties of figured space are investigated, arise two other subdivisions, pure and analytical geometry. The somewhat arbitrary subdivision into elementary and higher geometry arises from the fact that the geometrical books of Euclid's celebrated work, the *Elements*, treated only of plane figures composed of straight lines and circles, of solid figures with plane faces, and of the three round bodies, the sphere, the cylinder, and the cone.

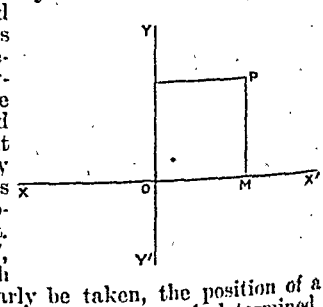
Other subdivisions of geometry arise from the threefold classification that may be made of the properties of space. These properties may be topological, graphical, metrical. The first class of properties are independent of the magnitude or the form of the elements of a figure, and depend only on the relative situation of these elements. Perhaps the simplest example that could be given of this class of properties is that if two closed contours of any size or shape traverse one another, they must do so an even number of times. No systematic treatise on this part of geometry has ever been drawn up, and it is only in papers scattered here and there in scientific journals that contributions towards such a treatise are to be found. The principal names under which such contributions are to be looked for are Euler, Gauss, Listing, Kirkman, and Tait.

The graphical or projective properties of space, which constitute the subject of projective geometry, are those which have no reference to measurement, and which imply only the notions of a straight line and a plane. A simple example of this class of properties is the well-known theorem of Desargues: If two triangles be situated so that the straight lines joining corresponding vertices are concurrent, the points of intersection of corresponding sides are collinear, and conversely.

The metrical properties of space are those which are concerned with measurement. An example of a metrical property is the theorem of the three squares: The square on the hypotenuse of a right-angled triangle is equal to the sum of the squares on the two sides. The geometry of Euclid's *Elements* is metrical.

Descriptive geometry is not so much a part of science as an art. It has for its object to represent on a plane which possesses only two dimensions, length and breadth, the form and position in space of bodies which have three dimensions, length, breadth, and height. This object is attained by the method of projections.

Analytical geometry is a method of representing curves and curved surfaces by means of equations. Before showing, however, how a curve can be represented by an equation, it will be necessary to explain what is meant by the co-ordinates of a point. If two axes, XX′, YY′, cutting each other perpendicularly be taken, the position of a point P in the same plane as the axes is determined,



if we know the distances of P from XX′ and YY′—i.e. if we know MP and OM. OM is called the abscissa, MP the ordinate of the point P, and the two together are called the co-ordinates of P. It is usual to denote OM and MP by x and y. If the point P be supposed to move in the plane according to some law, a certain relation will exist between its co-ordinates; this relation expressed in an equation will be the equation to the curve traced out by P. To take a simple example. Let the law according to which P moves be that its distance from XX′ shall always be double its distance from YY′; then the equation to the curve traced out by P will be $y = 2x$. If it be required to draw the curve traced out by P, we may assume any values for x, and from the equation determine the corresponding values for y. If we assume the values 1, 2, 3, &c. for x, the corresponding values of y will be 2, 4, 6, &c. Determine then the points whose co-ordinates are 1 and 2, 2 and 4, 3 and 6, &c.; these will be points on the curve. It is not difficult to discover that the curve is in this instance a straight line.

If the law according to which P moves in the plane be that it shall always be at the same distance from a fixed point, we have only to specify the distance (say c), and the co-ordinates of the fixed point (say a and b), and we shall find the equation which expresses this law to be

$$(x - a)^2 + (y - b)^2 = c^2.$$

If the distance be c, and the fixed point be the origin O whose co-ordinates are 0 and 0, the equation will be

$$x^2 + y^2 = c^2.$$

These last two equations are those of a circle.

As two co-ordinates are sufficient to determine a point in a plane, so a plane curve described according to a certain law will be represented by an equation between two variables, x and y; viz. $F(x, y) = 0$. It may be mentioned that equations of the first degree represent straight lines, those of the second degree represent some form of a conic section, those of higher degrees represent curves which in general take their name from the degree of their equations. The position of a point in space is fixed when its distances from three planes, usually taken perpendicular to each other, are known; in other words, three co-ordinates x, y, z determine a point in space. Hence, if a curved surface is given in form and position, and we can express algebraically one of its characteristic properties, and obtain a relation $F(x, y, z) = 0$ between the co-ordinates of each of its points, this equation is the equation of the surface; and every equation $F(x, y, z) = 0$, whose variables x, y, z are the co-ordinates of a point referred to three planes, perpendicular or oblique to each other, represents some surface, the form of which depends on the way in which the variables are combined with each other and with certain constant quantities.

The system of co-ordinates explained above is called the Cartesian, from Descartes. There are other systems, but a concise account of them would be unintelligible.

Of the history of geometry only the briefest outline can be given here, and this outline must be restricted mainly to pure geometry. Tradition ascribes (and modern research tends to confirm rather than to invalidate the ascription) the origin of geometry to the Egyptians, who were compelled to invent it in order to restore the landmarks effaced by the inundation of the Nile, but our knowledge of their attainments is meagre. From a papyrus in the British Museum written by Ahmes, possibly about 1700 B.C., we infer that the Egyptians discussed only particular numerical problems, such as the measurements of certain areas and solids, and were little acquainted with general theorems. The history of geometry, therefore, as a branch of science begins with Thales of Miletus (640–542 B.C.). The principal discovery attributed to him is the theorem that the sides of mutually equiangular triangles are proportional. After Thales came Pythagoras of Samos (born about 580 B.C.). It is difficult to separate the contributions which Pythagoras made to geometry from those of his disciples, for everything was ascribed to the master. The Pythagoreans appear to have been acquainted with most of the theorems which form Euclid's first two books, with the doctrine of proportion at least as applied to commensurable magnitudes, with the construction of the regular solids, and to have combined arithmetic with geometry. The theorem of the three squares, one of the most useful in the whole range of geometry, is known as the theorem of Pythagoras. Hippocrates of Chios, who reduced the problem of the duplication of the cube to that of finding two mean proportionals between two given straight lines; Archytas of Tarentum, who was the first to duplicate the cube; Eudoxus of Cnidus, the inventor of the method of exhaustions and the founder of the doctrine of proportion given in Euclid's fifth book; Menæchmus, the discoverer of the three conic sections; Deinostratus and Nicomedes, the inventors of the quadratrix and the conchoid; and Aristæus, are the principal predecessors of Euclid. To Euclid (about 300 B.C.) is due the form in which elementary geometry has been learnt for many centuries, and his treatise, the *Elements*, seems to have completely superseded all preceding writings on this subject. Those books of this treatise which are concerned with geometry are so well known that it is superfluous to refer to their contents. Archimedes of Syracuse (287–212 B.C.) is the greatest name in Greek science. Besides his important contributions to statics and hydrostatics, he wrote on the measurement of the circle, on the quadrature of the parabola, on the sphere and cylinder, on conoids and spheroids, and on semi-regular polyhedrons. Apollonius of Perga (260–200 B.C.) wrote on several geometrical subjects, but the work which procured him in his lifetime the title of 'the great geometer,' was his treatise on the conic sections. Ptolemy, author of the *Almagest*, Hero, and Pappus are the last important geometers belonging to the Alexandrian school.

After the destruction of Alexandria (about 640 A.D.) the study of geometry underwent a long eclipse. The Romans contributed nothing either to geometrical or indeed to any kind of mathematical discovery. The Hindus from the 6th to the 12th century A.D. cultivated arithmetic, algebra, and trigonometry, but in geometry they produced nothing of any importance. A somewhat similar statement may be made regarding the Arabs, but it ought to be remembered that they translated the works of the great Greek geometers, and it was through them that mathematical science was in the 12th century introduced into western Europe. From that time till the close of the 16th century, though editions of the Greek geometers were published and commented on, little or no advance was made in geometry comparable to what took place in other branches of pure or applied mathematics.

In the beginning of the 17th century Kepler and Desargues laid the foundations of modern pure geometry, the former by his enunciation of the principle of continuity, and by his extension of stereometry to solids of which the spheroids and conoids of Archimedes were particular cases, the latter by his introduction of the method of

projection. In 1637 Descartes gave to the world his invention of a [illegible] thus placing in the hands of [illegible] of the most powerful instruments of research, and withdrawing their attention from pure geometry. Pascal (1623–62), whose extraordinary precocity has often been cited, wrote an essay on conic sections at the age of sixteen. He afterwards wrote a complete work, one of the properties of which is the theorem of the mystic hexagram. His last work was on the cycloid. With the mere mention of the names of Wallis, Fermat, Barrow, Huygens, we pass to Newton, whose great work, the *Principia*, is the glory of science. Chasles thinks Newton's best title to fame is that he has raised such a monument of his genius by the methods and with the resources of the geometry of the ancients. The names of Halley, Maclaurin, Robert Simson, and Euler bring us down to near the end of the 18th century. During the 19th century a revival of interest in pure geometry has been brought about by Monge, the inventor of descriptive geometry, by Carnot, the author of the theory of transversals, by Poncelet and Gergonne. These have been succeeded by Möbius, Steiner, Chasles, and Von Staudt.

The best works on the history of Greek Geometry are Allman's *Greek Geometry from Thales to Euclid* (1889); Paul Tannery's *La Géométrie Grecque* (1887); Bretschneider's *Die Geometrie und die Geometer vor Euklides* (1870). Chasles's *Aperçu historique sur l'Origine et le Développement des méthodes en Géométrie* (1837 or 1875) and his *Rapport sur le Progrès de la Géométrie* (1870) embrace the whole field of Geometry. The following more general histories may also be consulted: Cantor's *Vorlesungen über Geschichte der Mathematik* (1880); Hoefer's *Histoire des Mathématiques* (1874); Marie's *Histoire des Sciences Mathématiques et Physiques* (12 vols. 1883–88); Montucla's *Histoire des Mathématiques* (1802); Gow's *Short History of Greek Mathematics* (1884); and Ball's *Short Account of the History of Mathematics* (1888).

George, a division of the western province of Cape Colony, on the south coast, east of Capetown. It contains 2600 sq. m., and about 11,000 inhabitants. It is valuable chiefly for its pasturage and its timber. The town of George stands 6 miles N. of the coast, and has a population of over 2000. On the coast is the port of Mossel Bay.

George, ST, the especial patron of chivalry, and tutelary saint of England. Although venerated both in the Eastern and Western churches, his history is extremely obscure, the extant accounts containing very much less history than legend. The story in the *Acta Sanctorum* is that he was born of noble Christian parents in Cappadocia, became a distinguished soldier, and, after testifying to his faith before Diocletian, was tortured and put to death at Nicomedia, April 23, 303. By many writers, as by Gibbon, he has been confounded with the turbulent and unscrupulous Arian partisan, George of Cappadocia, who after a troubled life as army contractor and tax-gatherer became Archbishop of Alexandria, and after five years of misgovernment was torn in pieces by a furious mob. Most authorities, Catholic and Protestant, agree in admitting the great improbability of this identification. Dr Peter Heylin is of one mind in this matter with the Jesuit Papebroch, and Dean Milman with the Roman Catholic Bishop Milner. Whatever may be said of the unhistorical character of St George's martyrdom, the fact of his being honoured as a martyr by the Catholic Church, of churches being dedicated to him, and of the Hellespont being called 'St George's Arm,' is traced by Papebroch, by Milner, and by other writers to so early a date, and brought so immediately into contact with the times of the angry conflicts in which George of Cappadocia figured as an Arian leader, that it is impossible to believe that the Catholics of the East—while the tomb of Athanasius was hardly closed upon his honoured relics—would accept as a sainted martyr his cruel and unscrupulous persecutor. The St George of the Eastern Church was no doubt a real personage of an earlier date than George of Cappadocia, but beyond this we can say nothing of him. His name was early obscured in fable—one oriental story making him suffer as many as seven martyrdoms, reviving after each save the last. The same story exists even in Mussulman legends, whose Chwolson identifies the hero with the Semitic Tammuz.

The famous story of St George's struggle with the dragon is first found in Voragine's *Legenda Aurea*, but soon found its way into the office-books of the church, until left out by Pope Clement VII. To slay a dragon was a common exploit for the saints and heroes of Christendom as well as of Teutonic and Indian antiquity; and St George here touches so closely the common myths of the Aryan family as to have himself been explained, by Baring-Gould and others, as in this aspect merely a mythical form of the sun-god dispelling the darkness by his beams of light.

Churches were dedicated to St George from very early times; the Crusades gave a great impetus to his worship, and he was adopted as the soldier-saint who led his votaries to battle. Many new chivalrous orders assumed him as their patron, and he was adopted as their tutelary saint by England, Aragon, and Portugal. In 1348 Edward III. founded St George's Chapel, Windsor, and in 1344 the celebrated Order of the Garter was instituted. See Baring-Gould's *Curious Myths of the Middle Ages*, and the article DRAGON.—The cross of St George, red on a white ground, was worn as a badge over the armour by every English soldier in the 14th and subsequent centuries. For the banner of St George, now represented in the Union flag, see FLAG.

George I., son of Ernest Augustus, Elector of Hanover, and of Sophia, granddaughter of James I. of England, was born in Hanover on 28th May 1660. Immediately after Queen Anne's death on 1st August 1714, he was proclaimed king of Great Britain and of Ireland in London, the proclamation at Edinburgh taking place four days, and at Dublin five days later. He had been Elector of Hanover since 1698, and he was the first monarch of the House of Brunswick who, in accordance with the Act of Settlement, succeeded to the throne of this country. He arrived at Greenwich on 29th September, and was crowned at Westminster on 31st October 1714. He had commanded the imperial forces in the war against France in which Marlborough acquired distinction, and, though less successful than Marlborough as a general, he was as chagrined as he when the Tory party, under the inspiration of Bolingbroke, made peace, and sanctioned the treaty of Utrecht. In 1682 he married his cousin, the Princess Dorothea of Zell. Twelve years later he obtained a divorce on the ground of her intrigue with Count Königsmark, and caused her to be imprisoned in the castle of Ahlden, where she died on 2d November 1726. While punishing his consort for her frailty, he lived openly with mistresses, and was neither ashamed of his conduct nor made to suffer for it.

The Tories and Jacobites who clung to the banished House of Stuart were the objects of his aversion, and the Whigs were favoured by him. Bolingbroke and the Duke of Ormond fled to France; both of them, and Oxford, who remained behind, were impeached. In Scotland a Jacobite rising, headed by the Earl of Mar, took place in 1715; a battle at Sheriffmuir on the 13th November, though indecisive, dispirited the rebels, who afterwards dispersed. Another body marched

into England, proclaimed James king at Penrith, and, being surrounded after reaching Preston, laid down their arms on the day of the battle at Sheriffmuir. The Earl of Derwentwater and Viscount Kenmure were executed on Tower Hill; many others were shot, and many were transported. A year after this abortive rebellion, parliament passed the Septennial Act, in order that by prolonging its own existence for four years the accession of the Tories to power might be hindered. More serious than any rebellion was the rise and fall of the South Sea Company (q.v.), the English counterpart of the Mississippi Scheme which beggared France. The king's personal part in the history of the reign was but slight, the actual ruler being Sir Robert Walpole. George I. could not speak English; Lord Granville was the only one of his ministers who could converse with him in German; the king and Walpole interchanged views in bad Latin. On this account the king did not preside at meetings of the cabinet. Queen Anne is the last sovereign of Great Britain who was present at a cabinet council. It was the delight of George I. to live as much as possible in Hanover, and to obtain as much money as possible from Great Britain. He died suddenly at Osnabrück, on his return from Hanover, on 9th June 1727. Lady Wortley Montagu styles George I. 'an honest blockhead.' If he had been an abler man he might have proved a worse sovereign. He was a useful figure-head in a constitutional government, and rendered greater service than he may have intended to the country which adopted him.

See the Histories of England by Stanhope, Hallam, and Lecky; the Stuart *Papers;* the *Life of Walpole*, by Coxe; the *Historical Register*.

George II. succeeded his father as Elector of Hanover and king of Great Britain and of Ireland. Born in Hanover on 30th October 1683, he was created Duke of Cambridge in 1706, and declared Prince of Wales in council in 1714. In 1705 he married Caroline of Anspach, a woman of many attainments and great force of character. She exercised great influence over her husband, and winked at his infidelities. When on her deathbed in November 1737 she implored him to marry again, he replied, with tears in his eyes, that he would rather keep a mistress. Though George interfered more in the government than his father had done, the policy pursued during his reign was first that of Walpole and second that of Pitt. During the greater part of Walpole's administration of the government peace was preserved; during the period that Pitt was almost supreme wars were fought and much glory was gained. In 1743 George II. was present and showed courage at the battle of Dettingen, the last occasion this on which an English sovereign has played a part in actual warfare. The rebellion in 1745 was ended at Culloden, where the adherents of the Young Pretender made their last stand. The Pretender had defeated General Cope at Prestonpans, and marched as far as Derby before succumbing to the royal forces under the command of the king's second son, the Duke of Cumberland, whose cruelty in dealing with the rebels caused him to be stigmatised as 'the Butcher.' The country prospered so well that in 1749 the funds rose above par. Pelham, the Chancellor of the Exchequer, effected a saving by reducing the interest on the national debt from 4 to 3½, and then to 3 per cent. Among the victories which made this reign glorious was that of Clive at Plassey and that of Wolfe at Quebec. The earlier years of the reign are pronounced by Hallam to be 'the most prosperous season that England had ever experienced.' George II. died suddenly on 25th October 1760. He had no conspicuous virtues. He may be credited, however, with a few pointed sayings. One was, 'What a strange country is this! I have never known but two or three men in it who understood foreign affairs.' Another was, 'Confidence is a plant of slow growth in an aged bosom.'

See the Histories of England by Stanhope and by Lecky; *Memoirs of the Reign of George II.*, by Harvey; Dodington's *Diary;* and Horace Walpole's *Memoirs of the last Ten Years of the Reign of George II.*

George III. was the eldest son of Frederick Lewis, Prince of Wales, and was born in London, at Norfolk House, St James's Square, on 4th June 1738. Being a seven-months' child, and very weakly, the boy was not expected to survive, and at eleven at night he was privately baptised by Dr Secker, who was Bishop of Oxford and rector of the parish of St James. On 2d July the bishop performed the ceremony publicly, the boy being named George William Frederick, and his sponsors being the King of Sweden, the Duke of Saxe-Gotha, and the Queen of Prussia. On 25th October 1760 George II. died suddenly, and his grandson ascended the throne. The new king was the first member of the House of Brunswick who commanded general respect on becoming the sovereign over Great Britain and Ireland. At the same time he became Elector of Hanover, a title which was exchanged for that of king in 1815, when he was incapacitated for performing his duties, and unconscious of what passed in the world. He was the only one of the four Georges who never visited his German dominions. In his first speech to parliament he said: 'Born and educated in this country, I glory in the name of Briton, and the peculiar happiness of my life will ever consist in promoting the welfare of a people whose loyalty and warm affection to me I consider the greatest and most permanent security of my throne.' These words were inserted by himself in the speech composed by the Earl of Hardwicke and approved by the ministry. At the outset George III. conciliated all classes of his subjects. Horace Walpole thus describes from personal observation the nature of the change: 'For the king himself, he seems all good nature and wishing to satisfy everybody. All his speeches are obliging. I saw him yesterday, and was surprised to find the levée-room had lost so entirely the air of the lion's den. The sovereign does not stand in one spot with his eyes fixed royally on the ground, and dropping bits of German news. He walks about and speaks freely to everybody. I saw him afterwards on the throne, where he is graceful and genteel, sits with dignity, and reads his addresses well.' On 8th September 1761 he married Charlotte Sophia, Princess of Mecklenburg-Strelitz, his bride being in her eighteenth and he in his twenty-third year. A fortnight after their marriage they were crowned. As a younger man he was supposed to have had children by Hannah Lightfoot, a beautiful Quakeress, and to have married her, but no proof of this marriage has ever been advanced. It is less open to doubt that, after ascending the throne, he wished to marry Lady Sarah Lennox, and that his mother used her influence to bring about a marriage with one who, like herself, was a German princess.

George III. owed it to his mother that he was strongly imbued with a desire to govern as well as reign. 'George, be king,' was the phrase which she repeated, and the training which he had received made him give heed to it. Bolingbroke, in writing the *Idea of a Patriot King*, had the expectation of persuading Frederick, Prince of Wales, and father of George III., to act the part. The substance of Bolingbroke's teaching was that a king should be the father of his people, that he was the man best qualified to know what would be for their good, and the one best entitled to make them do as he deemed right. Thus George III. felt certain that

his own way was the true one, and that were it followed all would go well. The friction which soon became manifest between him and his people was chiefly due to his determination to have his own way. Pitt was the popular idol; but the king disliked Pitt and his policy, and the Earl of Bute became prime-minister in the place of the Duke of Newcastle. It was commonly believed that Bute was both the favourite of the king and the lover of his mother; he was a Scottish nobleman who dispensed patronage to his countrymen, and he was execrated on account of his birth, his position, and his conduct. If he had been a strong man, he might have justified his promotion, but, being both timid and incompetent, he succumbed to popular clamour. His premiership lasted from May 1762 till April 1763. George Grenville, his successor, was premier for two years. The Marquis of Rockingham, who followed him, held the office for eleven months, the Earl of Chatham for fourteen months, and the Duke of Grafton held it for three years. These short-lived administrations were due to the king pitting one section of the Whig party against the other, in order to escape falling under the domination of the great Whig families, the result being that a party was formed which was known as 'the king's friends.' George III. found in Lord North a minister after his own heart, and Lord North remained at the head of the government from January 1770 till March 1782. During the administration of Lord North the thirteen united colonies proclaimed and achieved their independence, and were acknowledged by France and Spain as the United States of America. The determination of the king not to grant any concessions to those whom he deemed rebels caused the struggle to be protracted, and shut the door against compromise while compromise was possible. The subserviency of parliament and the acquiescence of the country enabled the king to have his own way. Lord North was succeeded by the Marquis of Rockingham, who died after he had been three months in office. Among his colleagues were Charles James Fox, Burke, and Sheridan, three of the most brilliant members of the Opposition, and three men whom George III. detested. Lord Shelburne, who was a member of the same administration, took Rockingham's place, but the colleagues just named and others refused to serve with him; on the other hand, he secured the services of William Pitt as Chancellor of the Exchequer. The friends of Charles James Fox and the followers of Lord North coalesced, and overthrew the Shelburne administration after it had been ten months in office; and the Duke of Portland became the head of a coalition ministry which entered office in April 1783, and was compelled to leave it, owing to the underhand action of the king, in December of that year. In the interval the definitive treaty of peace with the United States of America was signed, and the India Bill was brought before parliament, a measure of which Burke was the chief author, Fox the warm advocate, and George III. the irreconcilable foe.

In December 1783 William Pitt, then in his twenty-fourth year, formed an administration in which he was Chancellor of the Exchequer as well as First Lord of the Treasury, and he remained in office for eighteen years. The crushing victory of his party at the general election in 1784 was a triumph for the king as much as for Pitt. From that date there was an end to the supremacy of the old Whig families. The Tory party had been consolidated and was prepared to give effect to the policy of George III. The struggle had been long and severe. John Wilkes had taken part in it, and by his audacious resistance he had led to the abolition of general warrants. The writer whose letters were signed Junius had denounced the ministers whom the king trusted, and had warned the king himself that, as his title to the crown 'was acquired by one revolution, it may be lost by another.' That popular feeling ran high against the sovereign for a time is unquestionable, yet he gradually regained the affections of his subjects; hence, when it was announced in 1788 that he had lost his reason, there was a widespread sympathy with him. His eldest son had displayed vices from which he was free, and the people did not think the substitution of the Prince of Wales for the king would be a gain to the country. Two years before a mad [illegible] son, had tried to st [illegible] s of congratulation upon his escape then showed how general was the popular feeling. In 1765 he had an illness lasting two months, in which his reason was affected. On his recovery at that time there was no rejoicing such as took place when, on 23d April 1789, he went to St Paul's to render thanks for his recovery. The Prince of Wales, who had counted upon becoming regent, openly displayed ill-humour at his father's reception. A proof of public feeling was that a play in which Mrs Siddons took a leading part had to be withdrawn from the stage after one representation, because it bore the obnoxious name of 'The Regent.' The marriage of this son to Princess Caroline of Brunswick gave the king much gratification. It took place on 8th April 1794. Three years later the Princess Royal became the wife of the hereditary Prince of Würtemberg. The king's second son, the Duke of York, had married the eldest daughter of Frederick II. of Prussia in 1791. George III. had a large family; it numbered nine sons and six daughters, the first-child, the Prince of Wales, being born in 1762, and the last, the Princess Amelia, in 1783. The king had no fear of his children acting like his brother, the Duke of Cumberland, when he married Mrs Horton, or like the Duke of Gloucester, when he married the Countess of Waldegrave. The Royal Marriage Act, which was passed at his instance in 1772, forbade the members of the royal family marrying without the consent of the sovereign, if under twenty-five, or doing so after that age unless a twelvemonth's notice had been given to the Privy-council, and parliament had not expressed disapprobation within that period.

Though George III. was averse to war, he was strongly in favour of restoring the Bourbons to the throne of France. When the union between Ireland and Great Britain was proposed he wrote to Pitt characterising it as one of the most useful measures of his reign; but when the union was effected, and Pitt proposed carrying out his pledges with regard to the emancipation of the Roman Catholics and the endowment of the Roman Catholic priests, the king refused his assent, saying, as Lord Eldon records, 'I can give up my crown and retire from power; I can quit my palace and live in a cottage; I can lay my head on a block and lose my life; but I can *not* break my coronation oath.' Pitt resigned; George III. refused his advice to form a strong administration, including Fox. The king's hatred of Fox amounted to mania; he wrongfully attributed the bad conduct of the Prince of Wales to association with the great Whig leader. Hence the king entrusted Addington with the task of forming an administration, which held office till war with France was renewed, and the necessity for a firmer hand at the helm was apparent. Pitt resumed the office of premier, and died in 1806. A ministry was formed on 5th March 1806, in which Fox and Sidmouth held office, and of which Lord Grenville was the head; it was reconstituted after Fox's death on 13th September in that year, and it was succeeded in 1807 by one of which the Duke of Portland was the head, and in which Perceval was Chancellor of the

Exchequer, and Canning a secretary of state. In 1809 Perceval succeeded to the premiership, and this was the last administration in forming which George III. had any share. His jubilee was celebrated amid popular rejoicings on the 25th October 1809. In 1810 Princess Amelia, his youngest and favourite child, became dangerously ill; the unlikelihood of her recovery preyed upon him and hastened an attack of mental derangement, which incapacitated him for reigning. He had suffered from this malady more than once since 1789. In 1810 the Prince of Wales was appointed regent. Till his death, on 29th January 1820, at Windsor Castle (he was the first English king who died there), George III. was hopelessly insane. He lost his sight as well as his senses.

Though not a drop of English blood ran in his veins, yet George III. wa [illegible] He was well-meaning and [illegible] was truly pious and a pattern of the domestic virtues. His reign was marked by many vicissitudes, and it extended over sixty years. Decisive battles in America, India, and Europe were fought during its course, and many grand conquests were achieved. Great statesmen, such as Chatham, Pitt, and Fox, adorned it; great captains, such as Nelson and Wellington, made their names immortal; the greatest names in modern English literature then rose above the horizon; parliamentary oratory was at its zenith, and nothing was wanting to render the reign the most glorious in the country's annals but greater discretion on the part of the king. If George III. had been a little less of the typical Englishman, he might have been a more admirable sovereign. It was chiefly owing to his prejudices being respected by those who ought to have opposed them that war took the place of conciliation in America, and that war was prosecuted against France, when the interests of the country demanded neutrality among the contending powers on the Continent. When George III. ascended the throne the national debt, in round numbers, was £138,000,000 sterling; before his death it was upwards of £800,000,000. On the other hand, the trade and commerce of the country made gigantic strides during his reign. At his accession the exports did not exceed £12,000,000 sterling; at his death they were upwards of £50,000,000. The imports between that period rose from £8,000,000 to £36,000,000 sterling. At the beginning of the last forty years of his reign the number of newspapers in the three kingdoms was 61; at his death the number was 222. Several years before he died the *Times* newspaper was printed by steam, and the foundations of the daily press as it now exists were laid in the reign of a sovereign who was no favourer of newspapers. The greatest of his misfortunes was to be the father of the eldest son who succeeded him, and it is when George IV. is considered that the merits of George III. become the more conspicuous, and that 'Farmer George,' as he was familiarly called during his lifetime, appears a nobler figure in history than the 'First Gentleman in Europe,' as his eldest son was styled.

See the histories of England by Stanhope, Massey, Martineau, and Lecky; the *Memoirs and Letters of H. Walpole;* the *Grenville Papers;* the Chatham, Rockingham, Bedford, Auckland, and Malmesbury Correspondence; the *Letters of George III. to Lord North;* Burke's Works; the *Letters of Junius;* the *Annual Register;* and *The Opposition under George III.*, by Fraser Rae.

George IV., the eldest son of George III., was born in St James's Palace on 12th August 1762. He became Prince Regent in December 1810, after both houses of parliament had passed resolutions to the effect that the king was mentally incapacitated for discharging the duties of his office. He ascended the throne of the United Kingdom of Great Britain and Ireland after his father's death on 29th January 1820. Till the age of nineteen the prince was kept under strict discipline, against which he sometimes rebelled. When he was fourteen one of his tutors resigned on the ground of 'the ungovernable temper of his charge.' The Bishop of Lichfield, who then became his preceptor, gave the following forecast of the Prince of Wales: 'He will be either the most polished gentleman or the most accomplished blackguard in Europe; possibly an admixture of both.' At the age of eighteen the prince had an intrigue with Mrs Robinson, an actress, who obtained from him a bond for £20,000, and letters which she threatened to make public; she surrendered the letters for £5000, and the bond in return for an annuity of £400. When twenty he went through the ceremony of marriage with Mrs Fitzherbert (q.v.), a Roman Catholic, and by so doing forfeited his title to the crown. When the matter was mooted in the House of Commons, he desired Fox to deny there had been a marriage, and then he found fault with Fox for making the statement. Late in life he said to Lady Spencer, when consulting her about a governess for his daughter, 'Above all, I must teach her to tell the truth. You know that I don't speak the truth, and my brothers don't, and I find it a great defect from which I would have my daughter free. We have been brought up badly, the queen having taught us to equivocate.' The prince led a wild life. Out of antagonism to his father he affected to be a Whig, and associated with the leading members of the Opposition. When a lad he annoyed his father by shouting in his presence, 'Wilkes and Number 45 for ever!' When writing about his eldest son to Lord North, the king styled him an 'ill-advised young man,' and much of the king's aversion to Fox, Burke, and Sheridan was due to their associating with and advising the Prince of Wales. In 1795 he married Princess Caroline (q.v.) of Brunswick, being induced to do so by parliament agreeing to pay his debts, which amounted to £650,000. The prince had shown himself an undutiful son; he now showed himself to be a bad husband; and his conduct to his daughter and only child, the Princess Charlotte (q.v.), was that of a callous father. After becoming king he endeavoured to get a divorce from his wife, who was not more guilty than himself of conjugal crimes; but her death on 7th August 1821 terminated a struggle which had become a public scandal, and in which the people sympathised with the queen. Nothing in the reign of George IV. was more remarkable than his coronation, which was celebrated with as great pomp as that of any previous monarch, and with far greater splendour than that of William IV. or Queen Victoria. It took place on 19th July 1821, and it was described in the *Edinburgh Weekly Journal* by one who signed himself 'An Eye-witness,' and who was Sir Walter Scott. Eleven days after his coronation the king left London for Ireland, while his queen lay on her deathbed. In the *Irish Avater*, Byron writes of 'George the triumphant' speeding 'to the long-cherished isle which he loved like his—bride.' In October of the same year he went to Hanover, and was crowned king. He stopped at Brussels on the way and visited Waterloo, the Duke of Wellington acting as his guide. In August 1822 he went to Edinburgh by water, where he had a magnificent reception, of which Sir Walter Scott was the organiser. The last king who had visited Scotland before him was Charles II. Though a professed Whig when Prince of Wales, George IV. governed as his father had done by the aid of the Tories. Spencer Perceval, Lord Liverpool, Canning, Viscount Goderich, and the Duke of Wellington successively held office

as premiers while he was regent and king. The movement for reform which began in the reign of George III. was opposed, with the king's concurrence, by the advisers of George IV., the massacre at Peterloo, where the inhabitants of Manchester held a reform meeting on 20th August 1820, being the most regrettable of many sad incidents. On this occasion the open-air meeting was charged by cavalry and yeomanry, with the result that eleven persons were killed and about six hundred wounded. On the ground of his religious convictions, George IV. followed his father in opposing the emancipation of the Roman Catholics; but in 1829, when the Duke of Wellington declared that the measure was imperative, the king withdrew his opposition and the measure became law. His failings and vices were conspicuous; it cannot be said that they were wholly redeemed by his taste for music, by having a good voice for singing, and by playing fairly on the flute. It was creditable to him that he read and admired the inimitable romances of Jane Austen and Sir Walter Scott. Yet he did not adorn the throne, and when he died on 26th January 1830, he was least regretted by those who knew him best. See Justin M'Carthy, *A History of the Four Georges* (4 vols. 1889 *et seqq.*).

George V., of Hanover. See HANOVER.

George ('the Bearded'), Duke of Saxony (q.v.).

George, HENRY, was born in Philadelphia, September 2, 1839, went to sea at an early age, and in 1858 arrived in California, where he became a journeyman printer and married. After a number of years spent at the case, he rose to the editorial desk, conducted several papers, and took an active part in the discussion of public questions. In 1870 he published *Our Land and Land Policy*, a pamphlet outlining the views which have since made him widely known, but which had only a local circulation. In October 1879 appeared *Progress and Poverty* in California. In January 1880 it was published in New York, and in 1881 in London and Berlin. It has since gone through many editions, been translated into the principal languages, and had a circulation without precedent in economic literature. *Progress and Poverty* is an inquiry into the cause of industrial depressions, and of the increase of want with increase of wealth, in the course of which some of the most important of the hitherto accepted doctrines of political economy are recast. Denying the dictum that wages are limited by capital, he argues that wages are produced by the labour for which they are paid; and, denying the Malthusian theory, he contends that increase of population instead of causing want should tend to greater plenty. Then, by an examination of the laws of distribution, in which the laws of wages and interest are shown to correlate with the hitherto accepted law of rent, he comes to the conclusion that, as produce equals rent plus wages plus interest, therefore produce, minus rent, equals wages plus interest. The increase of economic rent or land values explains why the increase of productive power so marked in modern civilisation does not commensurately increase wages and interest. To the tendency of the steady increase in land values to beget speculation in land, which prevents the application of labour and capital, he traces the recurring seasons of industrial depression. The remedy he proposes is the appropriation of economic rent to public uses by a tax levied on the value of land exclusive of improvements, and the abolition of all taxes which fall upon industry and thrift. Meeting objections which may be urged against this proposition on the ground of justice and public policy, he finally brings it to a larger test in an examination of the law of human progress, which he defines to be that of association in equality. George has since written *The Irish Land Question* (1881), *Social Problems* (1882), *Protection and Free Trade* (1886). He visited Great Britain and Ireland in 1881, 1883, 1884, 1888, and 1889, speaking extensively through the country in support of his views. In 1886 he ran for mayor of New York as an independent candidate nominated by the working-men, receiving over 68,000 votes, and forcing the two powerful factions of the democracy into a coalition to prevent his success. In 1888 he as a free-trader supported Mr Cleveland. In 1887 George established a weekly paper in New York called the *Standard*. Though sometimes styled a socialist, George's views are for the most part diametrically opposed to state socialism. His aim is to sweep away all restrictions and interferences with the production and distribution of wealth, and only to resort to state control where competition is impossible—to leave to individuals all that individual energy or thrift accumulates, and to take for the use of the community all that is due to the general growth and improvement.

George, LAKE, called also *Horicon*, a beautiful lake, 32 miles long, near the eastern border of New York state. It forms the head-waters of Lake Champlain, is studded with hundreds of picturesque islands, and its shores contain several favourite summer-resorts, especially the village of Caldwell or Lake George. Here was fought the battle of Lake George, in which the French and Algonquins under Baron Dieskau were utterly defeated by the English and Iroquois under Sir William Johnson, on 8th September 1755.

George, THE, the badge of the Order of the Garter (q.v.).

Georgetown, a port of entry in the District of Columbia, is situated, partly on several eminences, on the Potomac, two miles above Washington, at the head of navigation. The heights are occupied by elegant villas, and command a fine view of the country around. Here the Chesapeake and Ohio Canal is carried across the Potomac by means of a great viaduct 1446 feet long. The city contains a number of educational institutions, including a Roman Catholic college (1789); and its many flour-mills enjoy a wide reputation. For its administration, see DISTRICT OF COLUMBIA. Pop. (1880) 12,578; (1885) 14,322.

Georgetown (formerly the Dutch *Stabroek*), capital of British Guiana, is situated on the right bank of the Demerara River, not far from its mouth. It is handsomely built, and consists of wide, clean streets, intersecting at right angles; the brightly painted wooden houses, with their Swiss eaves developed into handsome verandahs, are generally raised on piles a few feet above the unhealthy soil, and embosomed in trees, of which the cabbage-palm and cocoa-nut are the chief. Some of the streets, with their long colonnades of palms, are traversed by wide trenches or canals, with bridges at the cross streets. The principal public edifices are the government building, the cathedral, the Queen's College, and a museum and library. There are botanical gardens, several hospitals, an icehouse, and two markets. Water for ordinary purposes is supplied from a canal, the mains being laid through most of the principal streets; and artesian wells, besides tanks for the storage of rain, have to some extent supplied the lack of drinking-water. There is a short railway to Mahaica, and a telephone exchange has been established in connection with the government telegraph system. There is a good harbour, with a lighthouse, and defences erected within recent

years; the foreign trade is virtually that of the colony (see GUIANA, BRITISH). Pop. (1881) 47,175, including many coolies, and scarcely 5000 whites.

Georgia, the most southerly of the original thirteen states which composed the American confederation, is bounded N. by Tennessee, North Carolina, and South Carolina; E. by the Savannah River, which separates it from South Carolina, and by the Atlantic Ocean; S. by the St Mary River and Florida; and W. by the Chattahoochee River and Alabama. It lies between 30° 31′ 39″ and 35° N. lat., and in 81°—85° 53′ 38″ W. long., and has a maximum length and breadth of 320 and 256 miles, and an area of 59,475 sq. m.—a little more than the area of England and Wales. Upon the Atlantic Ocean it fronts for a distance of 128 miles; but the coast, low-lying and sandy, is bordered with islands, between which and the mainland are a number of sounds and creeks; so that the total coast-line is said to be about 480 miles.

The territory of Georgia presents five physical divisions: (1) The Sea Islands, famous for their cotton (see COTTON), and covered with a growth of oak, palmetto, magnolia, cedar, pine, and myrtle; (2) the Swamp Region, consisting of rich alluvial lands and deltas, formed by the fresh-water rivers, verdant with a dense and semi-tropical vegetation, and admirably adapted to the production of rice; (3) the Pine Barrens, with a thin soil, lying between these marsh grounds and the undulating red-clay lands of the interior, sheltered by vast forests of pitch-pine, which are highly prized as lumber and for naval purposes, but lonely and monotonous; (4) Middle Georgia, fertile, salubrious, hilly, crowned with forests of oak and hickory, the home of the short-staple cotton-plant, a fine fruit region, and yielding Indian corn, oats, wheat, and other cereals; and lastly (5) Cherokee Georgia, abounding in mountains, with fertile valleys, streams, and waterfalls. Cereals, grasses, and cotton are profitably grown among the valleys and upon the hillsides of Upper Georgia; and increasing attention is being bestowed upon the breeding of stock. In the central area of the last-mentioned division occurs the watershed, giving direction to the streams which flow respectively into the Gulf of Mexico on the one hand, and into the Atlantic Ocean on the other. The entire state is well watered. Of the rivers emptying into the Atlantic Ocean the most noteworthy are the Savannah, navigable as far as Augusta; the Great Ogeechee; the Altamaha, through its tributaries the Oconee and the Ocmulgee navigable as high as Milledgeville and Macon; the Satilla; and the St Mary. The streams belonging to the Gulf system are the upper waters of the Coosa; the Chattahoochee, navigable as far as Columbus; the Flint, navigable up to Albany; and the Alapaha.

With the exception of the swamp-region in the south and south-east of the state, the climate is salubrious and agreeable. The mean temperature is 78° in summer and 47° in winter; the annual rainfall nearly 50 inches. In the lowlands oranges and other semi-tropical fruits readily mature, whilst in the uplands peaches, apples, pears, &c. flourish; and fruits and market vegetables generally, being earlier than in the North, are exported in considerable quantities. The forests contain numerous species of oak, including the evergreen live-oak, which has been styled the king, as the *Magnolia grandiflora* has been styled the queen of the southern woods. Of great value is the long-leaf pine, furnishing both choice timber and naval stores. The list of useful native woods includes also the red, the white, and the post oak, the water-oak, the black walnut, the red cedar, the cypress, the poplar, and the locust. Among the indigenous flora are found valuable medicinal herbs and dye-plants; and the flowers often are of great beauty. Game is still abundant, in spite of the injury resulting from the failure to enact and enforce stringent laws for its preservation. Sea-fowl throng the coast and estuaries, alligators are numerous in the rivers, and food-fishes, oysters, clams, turtle, &c. are abundant. By reason of the denudation of their banks, rendering their waters turbid and causing unruly currents, the fresh-water streams have suffered material diminution in their animal life. From them food-fishes, once so abundant, have largely disappeared, and the pearl-bearing unio is now seldom seen; but the United States Fish Commission has been successful in the introduction of some varieties of fishes better suited to the changed condition.

The mineral wealth of Georgia is apparent in the gold-bearing strata of the Cherokee region, which for the past fifty years have been successfully worked, in extensive deposits of coal, in iron, copper, silver, and lead ores, in marbles of attractive varieties, in vast fields of granite and slate, and in the presence of gypsum, limestone, syenite, marl, buhrstone, soapstone, asbestos, shales, tripoli, fluor-spar, kaolin, clays, porcelain, aragonite, tourmaline, emerald, carnelian, ruby, opal, chalcedony, agate, amethyst, jasper, garnets, rose-quartz, beryl, and occasional diamonds. In 1837–64 the United States branch mint at Dahlonega coined gold bullion to the value of over six million dollars, mostly from metals extracted from the auriferous rocks of the adjacent territory. To the development of these mineral resources of the state much attention is being paid, and with profitable results. Prior to the civil war the inhabitants of Georgia were almost exclusively engaged in agriculture and commerce; but more recent industries are the lumber trade, and extensive cotton, woollen, and other manufactures. The most important mills are at Augusta, Columbus, Atlanta, Athens, and Roswell. Recent statistics show that there are now within the state 54 cotton and woollen mills, with 350,000 spindles and 8000 looms; while the lumber, flour, grist, and pulp mills, &c. are being multiplied, and the iron and steel trade in the north-western part of the state is overtaking the cotton manufacture in importance.

Although, since the civil war, the production of black-seed cotton on the sea islands and along the coast has materially diminished, the yield of short-staple cotton has greatly increased. The average crop of this variety will now approximate 1,000,000 bales, worth at the point of consumption or of export over $40,000,000. Of the other yearly agricultural products of Georgia the rice crop (25,000,000 pounds), the Indian corn (25,000,000 bushels), wheat, oats, sweet potatoes, and tobacco are important; and there is a yearly yield of 600,000 gallons of syrup, 650 hogsheads of cane-sugar, 5,000,000 pounds of butter, and 700,000 pounds of honey. From the ports of Savannah, Darien, Brunswick, and St Mary shipments of lumber and naval stores are annually increasing. Navigable rivers and an admirable system of railways (over 3000 miles), besides three short canals, furnish convenient transportation from the interior. Notably at Savannah, coastwise and foreign bound steamers and sailing-vessels convey the products of the region to the desirable markets of the world.

The state is divided into 137 counties, 10 congressional districts, 1 supreme judicial district, 21 judicial circuits, and numerous militia districts. Atlanta is the capital, and Savannah the commercial

metropolis. Augusta, Macon, Columbus, and Athens may be mentioned among the thriving cities and towns of this commonwealth. The population has steadily increased from 82,548 in 1790 to (1860) 1,057,286; (1870) 1,184,109; (1880) 1,542,180. It is now estimated to exceed 1,750,000, of whom the whites form slightly more than half.

There exists in Georgia a thorough system of free common schools; separate schools are conducted for both white and coloured pupils. Opportunities for higher education are afforded by the university of Georgia, at Athens, by its dependent colleges at Dahlonega, Milledgeville, Thomasville, Cuthbert, and Atlanta, and by sundry denominational colleges. At the university of Georgia and its dependent colleges tuition for Georgians is free. Georgia has also a school for the blind at Macon, for the education of the deaf and dumb at Cave Spring, and an asylum for lunatics near Milledgeville.

History.—The colony of Georgia was founded by James Oglethorpe (q.v.) in 1733, as a refuge for poor debtors and for the persecuted Protestants of Germany, and received its name in honour of George II. In 1752 Oglethorpe surrendered his charter to the British government. Georgia was thereafter classed as an English province, until, with her sister colonies, she succeeded in casting off her allegiance to the crown. Save during the few years of the civil war, she has since continued a component member of the confederation of the United States of America, and has long been regarded as the Empire State of the South. Despite the liberation of her slave population, which in 1860 numbered 450,033, and was valued at $302,694,855, and in the face of grievous losses occasioned by the war, the state has during the last quarter of a century manifested recuperative powers of a marvellous sort.

Georgia, the name formerly applied to the central portion of what is now Russian Transcaucasia (q.v.), bounded by the Caucasian mountains on the north and by the Armenian mountains on the south. The Russian name is Gruzia; the Persian Gurjestan, from which form the name Georgia probably arose, it being perhaps a corruption of Guria, the name of one of the western provinces. The early history of the Georgians, who pretend to trace their origin to Thargamos, a great-grandson of Japhet, is wrapped in fable. Mtskhethos, who is said to have built Mtsketha, the ancient capital of the country, situated near Tiflis, but now reduced to a mere village, plays a prominent part in it. We have also to deal with legend in the story of the Argonauts and Medea, who is said to have been born at Kutais. The Georgians first appear in authentic history in the time of Alexander the Great, to whom they submitted. After the death of Alexander in 323 B.C. they gained their independence under Pharnavas (302–237 B.C.). With Pharnavas begins the series of the kings (a title rendered in Georgian by the word *mephe*), who, under various dynasties, ruled the country almost uninterruptedly for more than 2000 years. In 265 A.D. the Sassanian dynasty ascended the throne in the person of King Marian, and ended with Bakour III. in 570. Towards the close of the 4th century Christianity was introduced by the preaching of St Nina, and in 469 Vakhtang built the city of Tiflis (Tbilisi), so called from the hot-springs found there. Soon after the death of Mohammed his followers entered the country and forced many of the inhabitants to embrace Islam. The Sassanides were succeeded by the powerful dynasty of the Bagratides, one of whom, Bagrat III. (980–1008), extended his dominions from the Black Sea to the Caspian; but during the eleventh century the Georgians twice suffered from an invasion of the Seljuks, who committed great devastations.

The country reached the height of its glory in the reign of Queen Thamar or Tamara (1184–1212), the daughter of George III. With her marriage to the son of the Russian prince, Andrew Bogoliubski, may be said to begin the connection between Russia and Georgia. The dominions of Tamara were more extensive than those of any other native sovereign, and her court was graced by the presence of many men of letters. But evil days were in store for Georgia. In 1220 and 1222 we hear of Mongolian invasions, and Tiflis was harried with fire and sword. Towards the end of the 14th century the country fell into the hands of Timour, who, however, was driven from it in 1403 by George VII. One of George's successors, Alexander (1413–42), committed the fatal error of dividing the kingdom between his three sons. The general history of Georgia now separates into two parts: that of the eastern states, Karthli and Kakheth, and that of the western states, including Imereth, Mingrelia, and Guria. From the 16th to the 18th century the Georgians suffered grievously from the Persians. In 1618 Shah Abbas invaded the country, and Teimuraz I. applied for help to the Czar Michael; in 1638 Levan, king of Mingrelia, took the oath of allegiance to Alexis; it was only from their co-religionists that the Georgians could hope for succour in their hour of need. They also suffered from the encroachments of the Turks. In 1795 the savage Aga Mohammed Shah invaded Georgia, and levelled Tiflis to the ground, carrying away a great number of captives. The aged king Heraclius II., an able sovereign, seeing that all resistance was in vain, fled to the mountains, where he soon afterwards died. His son, George XIII., resigned the crown in favour of Paul, emperor of Russia, in 1799; but his brother Alexander did not acquiesce in this arrangement, and held out for some time, but was defeated in a battle on the banks of the Ior. George died in 1800, and in the following year Alexander of Russia formally annexed the country. In 1810 the prince of Imereth attempted a revolt, which was quickly suppressed. Guria was finally united with Russia in 1829.

The former kingdom of Georgia is mainly included in the governments of Kutais, Tiflis, and Elizabethpol. The district is very fertile, being abundantly productive of cereals, wine—especially the Kakhetian—honey, and silk, of cattle and horses, while the mountains teem with mineral wealth, as yet little utilised. The Georgians belong to the Kartveli stock, forming the southern group of Caucasian peoples. Their numbers have been variously estimated. Some fix them at about 911,000, but Von Erckert (*Der Kaukasus und seine Völker*, Leip. 1887) gives the following calculation, as based in the main on the last census of 1881:

Georgians (in the restricted sense of the term)	350,000
Imeretians and Gurians	480,000
Adcharians and Lazes	20,000
Pshaves, living in the mountains	9,000
Thushes " "	6,000
Khevsurs " "	7,000
Mingrelians	215,000
Suanetians	13,000
	1,100,000

To this work is appended an excellent ethnological map. The Georgians and their congeners are of the Caucasian or Fair race (as opposed to the Mongolian or Yellow race). They are celebrated for their beauty, and under the Mohammedan rule the white slaves of western Asia and of Egypt were mostly drawn from among them and the Circassians. To the great credit of Russia this

disgraceful traffic was put an end to by the treaty of Kuchuk-Kainardji in 1774. Though endowed by nature with mental no less than physical advantages, the long course of oppression to which they have been subjected has had its effect upon their characters. But, despite the supremacy and brutal tyranny of their Mohammedan conquerors, they have as a nation remained faithful to the Christian religion, according to the doctrines of the Greek Church. In Guria, however, and the country of the Lazes, large numbers of the inhabitants were forced by persecution to embrace Islam, and in these districts the ruins of many churches may still be seen. The southern Caucasians, with magnificent physique, fertile soil, and enervating climate, are somewhat indolent; they are passionately fond of singing and music.

The four chief tongues—Georgian, Mingrelian, Suanetian, and Lazian, which some have called the Iberian group—stand to each other more in the relation of languages than dialects, although they certainly all had a common origin; Mingrelian especially has greatly diverged. Georgian alone of the four has a literature, if we except the few folk-tales of the Mingrelians. These languages are of the agglutinative type; the chief difficulty lies in the verbs, which incorporate the pronominal prefixes and suffixes. In their structure they resemble Basque, but no affinity can be established between these two families of languages, as their vocabularies have no word in common.

The Georgians use two alphabets—the *khutsuri* or ecclesiastical, and the *mkhedruli* or civil: the first is only employed in the religious books. They are very old, and legendary accounts are given of their origin. The ecclesiastical resembles the Armenian alphabet; the civil is a very pretty character, with many rounded letters, which make it somewhat resemble Burmese. Georgian literature is by no means poor. Professor Tsagarelli gives a list of 946 Georgian MSS. known to exist; they are preserved in monasteries at Jerusalem, on Mount Athos and Mount Sinai, and at Tiflis, in the library of the Society for the Diffusion of Education among the Georgians. Besides these, there are 36 MSS in the Bibliothèque Nationale in Paris, and 34 in private hands at Tiflis. Further search will, no doubt, bring to light others. As far as it can be traced back, the literature begins about the 5th century A.D., with translations of the Scriptures and the Fathers, and later on we get versions of the Greek classical authors, including Plato, Aristotle, and Josephus. To the 7th century belongs a fine psalter on papyrus, and there is a complete manuscript of the Bible of the 10th, preserved at Mount Athos. The great literary development, however, of the country was during the 11th and 12th centuries, and especially in the reign of Queen Tamara. To this period belongs the popular epic, 'The Man in the Panther's Skin' (*Vephkhvis-tkaosani*), a poem narrating the love of Avtandil for Tinatina, daughter of the Arabian king Rostevan, and that of Tariel for Nestan Darejan, daughter of the Indian king Parsadan. It is a richly-coloured work, as if written by an oriental Tasso, and enjoys great popularity among the Georgians at the present day, many of the couplets—it is written in quatrains—having passed into proverbs. The author, Shota Rustaveli, was the glory of the reign of Queen Tamara, and is said to have died at Jerusalem as a monk in 1215. A handsome illustrated edition of this work appeared at Tiflis in 1888. Of Shavtel, another poet of the time who also enjoyed considerable reputation, only a few odes have come down. Chakhrukhadze composed a long and rather tedious poem in honour of the famous queen; prose tales were written by Sarkis of Thmogvi, the most celebrated being the *Visramiani*, and a poem by Mose of Khoni, called *Daredjaniani*. Now that the Georgians have been secured by Russian protection from their Moslem foes, they are busy in studying their old literature and editing their MSS. Somewhere about the same time as these authors flourished was begun the Georgian chronicle, called *Karthlis Tskhovreba*, or life of Georgia, the first part of which is anonymous, and carries the history from the earliest times to the year 1224; a continuation, also anonymous, brings it down to the year 1445.

But this brilliant period was destined to a temporary eclipse; during the 14th and the next two centuries the country was a prey to Mongols, Tartars, Persians, and Turks; the cities were devastated, many of the inhabitants were carried into captivity, and valuable MSS. were lost or destroyed. In the 17th century, however, matters began to mend. Towards the close flourished Saba Sulkhan Orbeliani, one of the most learned men of his time, who visited Paris, where he was well received by Louis XIV., and Rome. To him his countrymen are indebted for the first dictionary of their language, called, in oriental style, 'The Bouquet of Words;' it was edited at Tiflis in 1884. His also was the popular work, 'The Book of Wisdom and Falsehood' (*Tsigni Sibrmnè-sitsruisa*), a collection of amusing fables and apologues, some of his own invention, and others drawn from the stores of Georgian and other oriental folk-tales. A Russian translation of this interesting book has been published by Professor Tsagarelli of St Petersburg.

In 1709 King Vakhtang VI. established a printing-press at Tiflis. One of the works which appeared was 'The Man in the Panther's Skin,' to which he added a curious mystical commentary, giving the book a religious meaning, perhaps to rehabilitate it among the clergy, who regarded it as a profane work. Vakhtang also laboured at a translation of the *Kalilah and Damnah*, in which he was assisted by Sulkhan Orbeliani (edited at Tiflis in 1886). This king, thinking his country lost on account of a fresh invasion of the Turks, emigrated to Russia with many Georgian families, and in consequence of their presence in the country the great Georgian Bible was published at Moscow in 1743. To this century also belong the *Davithiani*, a poem by Guramishvili, and the first Georgian grammar, by the Catholicos (Primate) Anthony, besides other works. Vakhusht, the son of Vakhtang, continued the chronicle of his country till 1745, and wrote a geographical description of it, a work of great value. Since the peaceful settlement of Georgia under the Russians, literature has been greatly developed. The fine lyric poets, Alexander Chavchavadze (whose daughter married Griboiedov, the Russian dramatist), Raphael Eristavi, Nicholas Baratashvili, and Akaki Tsereteli, have appeared. The most conspicuous literary man of Tiflis at the present time is Prince Ilya Chavchavadze, author of some of the most graceful lyrics in the language, and some spirited tales in which he has satirised the luxury and other weaknesses of his countrymen. He is editor of the Georgian literary and political daily journal, *Iberia*. Some of the plays of Shakespeare, among others *Hamlet* and *Othello*, have been translated by Prince Machabeli. Altogether, Georgian literature may be said to be in a flourishing condition.

The pioneer in the study of Georgian history and philology was Brosset, who published *Eléments de la Langue Georgienne* (Paris, 1837), an elaborate edition of the *Georgian Chronicle* (St Petersburg, 1849-58), and many other works. Chubinov's *Gruzinsko-russko-frantsuskii Slovar*, *Dictionnaire Georgien-français-russe* (St Petersburg, 1840), and *Russian-Georgian Dictionary*

(1846; new ed. 1886); Prof. A. Tsagarelli's *Sviedienia o pamiatnikakh gruzinskoi pismennosti* (in Russian; 'Notices of the Monuments of Georgian Literature,' p[illegible] 1886), and *Mingrelskie Etiudi* [illegible]tersburg, 1888); and A. Leist's *Georgische Dichter veraeutscht* (Leip. 1887) may be mentioned. See also Wardrop, *The Kingdom of Georgia* (1888).

Georgia, Gulf of, an arm of the Pacific, between Vancouver's Island and the mainland of British Columbia, communicating with the ocean by Queen Charlotte's Sound in the north, and by the Strait of Juan de Fuca in the south. It exceeds 30 miles in breadth, and has a length of nearly 250 miles.

Georgian Bay. See Huron (Lake).

Georgic. See Bucolic.

Georgswalde, a town on the northern border of Bohemia, 112 miles N. of Prague by rail, with a mineral spring, and linen manufactures. Pop. 5604.

Gephyrea, a class of unsegmented marine worms, divided into two distinct sub-groups: (*a*) the Gephyreans proper, without bristles (*G. achæta*)—e.g. *Sipunculus* (q.v.), *Priapulus*, *Phascolosoma*; and (*b*) the Echiuroids or armed Gephyreans (*G. chætifera*)—e.g. Echiurus, Thalassema, Bonellia (q.v.). They live at the bottom of the sea, in sand, mud, or among rocks. While the adults of both sub-groups are not segmented, the larvæ of the Echiuroids are, and on this and other grounds many authorities place them apart from the other Gephyreans and nearer the Annelids.

See Selenka, 'Gephyrea,' *Challenger* Rep. xiii. (1885); De Mace, Bülow, and Selenka, 'Die Sipunculiden,' in Semper's *Reisen im Archipel der Philippinen*, part ii. (1884); Rietsch, 'Monograph of Echiuridæ,' *Recueil Zool. Suisse*, iii. (1886).

Gepidæ, a people of Germanic origin, whom we first read of as settled about the mouth of the Vistula in the 3d century. Before the 5th century they had migrated to the Lower Danube, where they were subjugated by the Huns; but, revolting against Attila's son, they recovered their freedom and established themselves in Dacia. There their power grew so great that they levied tribute from the Byzantine emperors down to Justinian's days. In the end of the 5th century a powerful enemy arose to them in the Ostrogoths; and after them came the Longobards, who, in alliance with the Avars, inflicted a crushing defeat upon the Gepidæ in 566. A part of the last-named then submitted to the Avars, whilst a part accompanied the Longobards to Italy. Henceforward we hear of them no more.

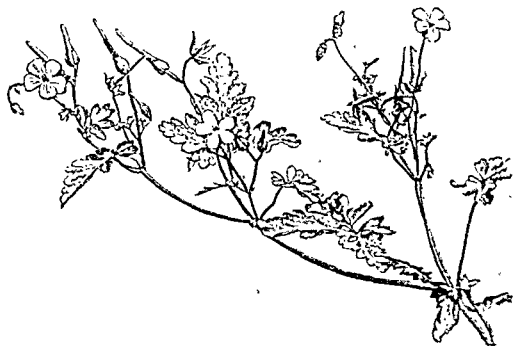
Gera, a town of Germany, capital of the small principality of Reuss-Schleiz, is pleasantly situated on the White Elster, 42 miles E. by S. of Weimar by rail. Nearly destroyed by fire in 1780, it is for the most part a modern town, with broad and regular streets, but its older buildings include a castle and a fine town-hall. There are over a score of extensive woollen factories, besides cotton-works, dyeing and printing works, manufactures of machinery, leather, tobacco, and beer for export, and four publishing houses; and eight establishments, employing 1500 hands, turn out thousands of melodeons, accordions, and jews'-harps yearly. Pop. (1843) 11,300; (1880) 27,118; (1885) 34,152, nearly all Protestants.

Gerace, a town of southern Italy, 4 miles from the sea, and 37 (58 by rail) NE. of Reggio. It has a cathedral, rebuilt after the earthquake of 1783, and a trade in wine, especially the esteemed *Lacrima di Gerace*. There are iron-mines and a hot sulphur-spring close by, and on a neighbouring plain are the ruins of the ancient *Locri*. Pop. 5265.

Gerando. See Degerando.

Geraniaceæ, an order of thalamiflora dicotyledons, herbs or undershrubs of temperate countries, particularly abundant at the Cape, and of which the leading genera Geranium, Pelargonium, and Erodium yield a great number of garden and greenhouse plants (see Geranium). In a wider sense the order is extended to include the closely related Lints (Linaceæ) and Sorrels (Oxalidaceæ), together with the curiously specialised Balsaminaceæ, and sometimes also the Tropæolaceæ (see Tropæolum), of which, however, the affinity is more doubtful.

Geranium, the typical genus of Geraniaceæ, which includes about 100 perennial and annual herbs. The popular name (Crane's-bill) is derived from the resemblance to the crane's beak presented by the beak-like process attached to the fruit, this curiously assists in the distribution of the seed by its characteristic mode of splitting spirally into awn-like processes and carrying the seed along with them. Twelve species are natives of the woods, hedgerows, and fields of Britain. Of these several are cultivated in gardens, especially *G. sanguineum*, with its variety *lancastriense*, and the double-flowered form of *G. sylvaticum*, one of the handsomest of border flowers, while among pretty exotic species may be named *G. armenum*, *platypetalum*, &c. Several are of old medicinal



Herb Robert (*Geranium Robertianum*).

repute, notably *G. Robertianum* (Herb Robert or Stinking Crane's-bill), which emits a strong disagreeable odour that is said to banish bugs: it is indigenous in the United States. *G. maculatum* is the Alum Root of North America—a root so powerfully astringent as to be employed, both by the Indians and the European settlers in the United States, in domestic medicine for many disorders requiring the exhibition of astringents. *G. carolinianum* is another American species. A few species produce edible tubers—e.g. *G. tuberosum* of South Europe, and *G. parviflorum*, the Native Carrot of Tasmania. The name Geranium is, however, often popularly misapplied to the members of the allied genus Pelargonium; witness the so-called 'scarlet geranium,' 'ivy-leaved *geranium*,' &c. See Pelargonium.

Gérard, Étienne Maurice, Comte, Marshal of France, was born at Damvilliers, in Lorraine, 4th April 1773. Volunteering into the army in 1791, he associated his fortunes for some years with those of Bernadotte, serving on the Rhine, in Italy, in the [illegible] in Germany, and in Spain, where [illegible] himself at Fuentes de Oñ[illegible] vices at Austerlitz (1805) he was appointed general of brigade; he also took a notable part at Jena (1806), Erfurt (1806), and Wagram (1809). During the Russian campaign of 1812 he rendered conspicuous service at the capture of Smolensk, in the battle of Valon-

tina-Gora, and at the passage of the Beresina. After Napoleon's return from Elba he commanded a division at Ligny, and was wounded at Wavre. The second restoration compelled him to leave France, and he did not return till 1817. In 1831 he commanded the French army sent to the assistance of the Belgians against the Dutch, whom he drove out of Flanders, and on 27th December 1832 compelled the citadel of Antwerp to capitulate. After the July revolution of 1830 he was appointed marshal and war-minister by Louis-Philippe; he was again war-minister from July to October in 1834. He died at Paris, 17th April 1852.

Gérard, BARON FRANÇOIS PASCAL, painter, born of French parentage at Rome, 11th March 1770, at ten was brought to France, and at sixteen became the pupil of David. In 1795 he exhibited 'Belisarius,' which first brought him into notice; shortly afterwards he painted 'Psyche receiving the First Kiss from Cupid.' Previous to this he had already begun to work at portrait-painting, his portrait of Madame Bonaparte in 1799 being the beginning of his career as the 'painter of kings.' Almost all the royal and other celebrities who visited Paris between 1799 and 1837 were painted by Gérard, who owed his success not alone to his skill as a portraitist, but also to the charm of his manners and conversation. The grandest of his works are, however, historical pictures, the 'Battle of Austerlitz' (1810) and the 'Entry of Henry IV. into Paris' (1814). Gérard was appointed first court-painter and raised to the rank of baron by Louis XVIII. He died at Paris, 11th January 1837. Gérard's most celebrated portraits are those of Napoleon in his coronation robes, the Queen of Naples and her Children, Talleyrand, Talma, Louis-Philippe, and Madame Récamier. See books by Adam (3 vols. 1852–57) and H. Gérard (1867).

Gerard, JOHN, herbalist, was born at Nantwich, in Cheshire, in 1545. Settling in London, he kept Lord Burghley's gardens for over twenty years, practised as a barber-surgeon, becoming master of the company in 1608, and died in 1612. His famous *Herball* was published in 1597, mainly based upon the *Stirpium Historiæ Pemptades* (1583) by Rembert Dodoens. An enlarged edition of Gerard's *Herball* was issued by Thomas Johnson in 1633.

Gérard, caricaturist. See GRANDVILLE.

Ger'asa, in the time of the Romans, a flourishing city of Palestine, was situated among the mountains of Gilead, about 20 miles east of the Jordan. It is now deserving of notice solely on account of its ruins. Great portions of the city wall are in good preservation; three of the gateways are almost perfect; two theatres and several temples can be identified amongst the public buildings; and within the city more than 230 columns are still standing on their pedestals.

Gerbert. See SYLVESTER II.

Gerhardt. KARL FRIEDRICH, chemist, born at Strasburg, 21st August 1816, at fifteen was sent to the Polytechnic School of Carlsruhe, and afterwards studied chemistry at Leipzig, and under Liebig at Giessen. In 1838 he arrived in Paris, where he lectured on chemistry, and where with his friend Cahours he commenced his researches on the essential oils. In 1844 he was appointed professor of Chemistry at Montpellier. About this time he published his *Précis de Chimie Organique*, in which he sketches the idea of 'Homologous and Heterologous Series.' In 1845–48, in association with Laurent, he published the *Comptes rendus des Travaux de Chimie*. In 1848 he resigned his chair and returned to Paris in order to follow out uninterruptedly his special investigations; and in that city he established, between the years 1849 and 1855, in successive memoirs, his views of series and the theory of types with which his name is associated in the history of chemistry. It was there, also, that he gave to the scientific world his remarkable researches upon the anhydrous acids and the oxides. In 1855 he became professor of Chemistry at Strasburg. All his ideas and his discoveries are embodied in his *Traité de Chimie Organique* (4 vols. 1853–56). He had hardly completed the correction of the last proof of this great work, when, after an illness of only two days, he died on 19th August 1856. See the Life by his friend Cahours.

Gerhardt, PAUL, perhaps the best writer of hymns that the German Lutheran church has produced, was born at Gräfenhainichen, in Saxony, 12th March 1607, became dean at the church of St Nicholas in Berlin in 1657, but, in consequence of his opposition to the elector Frederick-William's attempt to bring about a union of the Lutheran and Reformed churches, was banished from Brandenburg in 1666. The last seven years of his life he was pastor of Lübben, where he died, 6th June 1676. He wrote 123 hymns, all excellent, and many of them worthy to be placed amongst the choicest productions of Protestant sacred poetry. The one beginning 'Commit thou all thy ways' is well known in England from Wesley's translation. Other exquisitely tender lyrics are 'Nun ruhen alle Wälder' (Now all the woods are sleeping), 'O Haupt voll Blut und Wunden' (O wounded head and bleeding), 'Du bist zwar mein, und bleibest mein' (Thou 'rt mine, yes, still thou art mine own).

Gerizim and Ebal, the two highest mountains in the central Palestine chain, celebrated in Scripture story. They are separated from each other by a deep narrow valley, in which stands the town of Nâbulus, the ancient Shechem, the metropolis of the Samaritan sect. The tops are about 3000 feet above sea-level; both are of hard limestone, bare, and with cliffs on their sides. The valley between them is 1500 feet deep, very fertile, with springs and fruit-gardens. Jacob's well stands where the vale joins the plain of Moreh. On the slope of Ebal to the north of the well is Sychar (now 'Askar). The view from the top of Mount Gerizim, the southern hill, embraces glimpses of the blue waters of the Mediterranean on the west, with the plains of Sharon and Cæsarea, the snow-capped heights of Hermon on the north, and on the east the plains of Moreh, and beyond the mountains of Gilead. Mount Gerizim, along with Mount Ebal, was the scene of a grand and impressive ceremony, in which the whole people of Israel took part after crossing the Jordan, in obedience to a command which Moses had given them (Deut. xxvii.). The half of the tribes standing on Gerizim responded to and affirmed the blessings, those on Ebal the curses as pronounced by the Levites. The Samaritans built a temple on Mount Gerizim as a rival to that of Jerusalem, and organised a rival priesthood; and the Samaritan Pentateuch closed the Decalogue with the injunction, 'Thou shalt build a temple on Mount Gerizim, and there only shalt thou worship.' And, though the Samaritan temple was destroyed by Hyrcanus about 200 years after, the mountain on which it stood continued to be held sacred by the Samaritans. It was to Mount Gerizim that the 'woman of Samaria' referred when she said to our Saviour: 'Our fathers worshipped in *this* mountain, and ye say that in Jerusalem is the place where men ought to worship.' Subsequently, a Christian church in honour of the Virgin was built on it.

Germ, a name applied to the egg-cell of plant or animal, either from the first or in its early

stages; but also used in reference to micro-organisms associated with disease (see BACTERIA, &c.). By 'germ-cells' the reproductive elements, especially the ova, are meant; while 'germ-plasma' is a very common modern word for the most essential parts of the nuclei in the reproductive cells. See EMBRYOLOGY, HEREDITY.

GERM THEORY OF DISEASE, as the name implies, seeks to find the explanation of certain well-recognised conditions of disease in the presence and action of specific living organisms within the affected body. Though comparatively recently introduced as an efficient working hypothesis in the investigation of some hitherto ill-understood pathological phenomena, the correctness of the theory is now generally admitted. The facts which it has aided in establishing and the numberless investigations which it has inspired have created an important department of medical science. The study of bacteriology (see BACTERIA) has awakened fresh interest in almost every branch of medicine; and the subject possesses a large and extensive literature of its own.

The evolution of the theory was due mainly to two factors: (1) The discussions and investigations which circled round the process of fermentation; (2) the application of more perfect microscopical methods to the study of the lowest forms of plant and animal life.

(1) The familiar process of Fermentation (q.v.) gave birth to much debate. The earlier chemists (Gay-Lussac, and more recently Liebig) held that fermentation was merely the result of the process of decay of organic matter. Various modifications of this doctrine, which cannot be considered here, were enunciated, but the general conclusion remained the same. On the other hand, so early as 1812, Appert had demonstrated from the practical side that organic substances capable of fermentation or putrefaction could be preserved intact if kept in closely stoppered bottles which were afterwards exposed to the temperature of boiling water. In 1836 Caignard-Latour described an organism, the yeast plant, which he affirmed to be constantly present in the fermenting fluid. Its growth and reproduction he believed to proceed synchronously with the fermentation. Schwann (1837) described this organism independently, and Helmholtz (1843) confirmed the observation. They maintained that the process, in place of being a mere decomposition, was vital and depended on the presence of the organism they had discovered. This revolutionary doctrine was further elaborated pre-eminently by Pasteur and by Schultz, Schroeder, Dusch, Lister, Tyndall, and others. Their researches showed that fermentation was caused by the presence of these organisms; that the exclusion of these from fluids capable of fermentation, by various methods of sterilisation and filtration of the air in which they were abundantly present, was sufficient to prevent its occurrence; that the doctrine which attributed the production of fermentation to the influence of certain gases—e.g. oxygen (Gay-Lussac)—was erroneous; that the idea of the spontaneous generation (see SPONTANEOUS GENERATION) of such organisms within properly sterilised and protected fluids (Needham, Bastian, Pouchet, Huizinga) was fallacious; and that the so-called putrefaction was but one variety of fermentation.

(2) One result of these discussions was to develop a refinement of the methods of microscopical research, more especially with reference to the investigation of the lowest forms of life (see BACTERIA). Though bacteria had been recognised and described in the 17th century (Leeuwenhoek), it is mainly to the researches of the latter half of the 19th century that we are indebted for an approach to an accurate knowledge of the life-history of these organisms. By the masterly labours of Cohn, De Bary, Zopf, Van Tieghem, Nägeli, Klebs, Koch, and many others, the methods of demonstration have been improved to an extraordinary degree. The elaboration of staining methods alone, in conjunction with the use of perfected lenses, has made possible the detection and examination of minute organisms hitherto unrecognisable.

It is impossible to say when the idea of an analogy between the familiar phenomena of fermentation and those of acute disease first arose. It is certain that before the 19th century there had been prevalent an ill-defined feeling after something of the kind. More than two hundred years ago Robert Boyle (1627–91), in his 'Essay on the Pathological Part of Physik,' clothes the idea in words which, as Tyndall has said, 'have in them the forecast of prophecy.' The idea received more definite formulation in consequence of the researches into the nature of fermentation just referred to. In 1848 Fuchs stated that he had discovered bacteria in animals which had died of septicæmia. In 1850 it was announced (Davaine, Branell, Pollender) that *bacilli* had been detected in the carcasses of animals affected with anthrax. The discovery was corroborated by various observers. But it was not till the disease had been induced by the inoculation of healthy animals with a minimal quantity of the organism (Davaine) that the *Bacillus anthracis* was recognised as the cause of the disease. Thus was afforded the first substantial proof of the germ theory. This success inspired further research on kindred lines. In comparatively quick succession other discoveries were announced, till, in 1882, Koch described the *Bacillus tuberculosis* as the organism responsible for the scourge of consumption, and in 1883 the bacillus of cholera.

Emphasis must be laid on the statement that the discovery of an organism in the circulation or tissues of a diseased animal cannot be accepted as proving the causal efficacy of the former. Apart from further experiment, it were perfectly fair to argue that such organism was a mere accompaniment of the morbid state, flourishing on the dying or diseased tissues. And, in fact, such secondary factors are recognised. It has, moreover, frequently happened that competing claims have been advanced in explanation of the same disease. It was necessary, therefore, that there should be formulated (Klebs, Koch) certain conditions, since known as Koch's postulates, which must be fulfilled by an organism whose causal relationship with a given disease is maintained. These are as follows: (1) The organism must be demonstrated in the circulation or tissues of the diseased animal; (2) the organism, so demonstrated, must be capable of artificial cultivation in suitable media outside the body, and successive generations of *pure cultivation* obtained; (3) such pure cultivation must, when introduced into a healthy and susceptible animal, produce the given disease; (4) the organism must again be found in the circulation or tissues of the inoculated animal. The claims of organisms which fail to meet these demands must be set aside to await further proof.

The number of diseases whose specific origin is now generally admitted is comparatively large, but of few of these can we speak with the same certainty as may be done regarding consumption (tuberculosis) and splenic fever (anthrax). In other words, the fulfilment of all four postulates by many of them has not been demonstrated or has been disputed. Besides anthrax and tuberculosis, the list includes leprosy, cholera (Asiatic), relapsing fever, typhoid fever, yellow fever, malaria, diphtheria, dysentery, syphilis, acute pneumonia,

gonorrhea, septicæmia, erysipelas, actinomycosis, &c. With considerable probability we may add whooping-cough, measles, scarlatina, typhus, smallpox, hydrophobia, tetanus, British cholera, &c.; but the evidence regarding these and others is defective, and, in some cases, less substantive than analogical.

The specific organisms associated more or less exactly with those diseases are members of the groups (*a*) Coccaceæ and (*b*) Bacteriaceæ (see BACTERIA).

The admission that certain diseases are due to the presence and action of specific living organisms raises the further questions: (1) How do they enter the body? (2) How do they act?

(1) How do they enter the body? It has been conclusively shown that the *Bacillus tuberculosis* may obtain access by the inhalation of germ-laden air, by the ingestion of affected milk and possibly of tubercular meat, perhaps, too, through a cut or sore. It seems also likely that the bacilli may be transmitted from mother to fœtus by way of the circulation. Similar lines of attack may be predicated of all the pathogenic organisms. Notably, in connection with wounds, it is important to bear in mind the possibility of infection with the germs which induce septicæmia—a fact on which was based the great advance in surgery associated with the name of Lister. See ANTISEPTIC SURGERY.

The possibility of infection varies much according to the conditions of growth of the particular organism and the receptivity of the host. This explains, on the one hand, the popularly accepted view that certain diseases are much more infective than others. Thus, typhoid fever differs widely from scarlatina in respect of degree of contagiousness. On the other hand, some persons undoubtedly are more susceptible to the attacks of certain organisms. Thus, among the subjects of tuberculosis, it is probable that preparedness of soil plays an important part in the production of the disease. And so with other pathogenic organisms. These processes have their analogy in the more common phenomena of vegetable life. Sow some seeds and they will germinate and grow on any soil, however unlikely. Other seeds may be scattered profusely, but will not develop, unless the soil has been carefully prepared and the other conditions of growth be fulfilled. It is impossible to enter here on the discussion of those conditions. Necessarily they vary much with different organisms. But it is important to realise the extreme value, from the therapeutic point of view, of their careful study. The first step to a rational treatment of such diseases is to *know* the responsible organism. This knowledge must include not only its shape and other physical characters, but the life-history of the microbe, and the conditions which assist or retard its development and reproduction. Such knowledge affords the only sound basis for a system of *preventive* medicine, which constitutes one of the most important departments of practical hygiene. Although still in its infancy, the preventive treatment of endemic, epidemic, and other contagious diseases has now become scientific.

(2) How do the organisms act? This is a much-debated question. It has been the subject of some of the most valuable of recent researches in this department. Do they act mechanically as irritants? Or is their action privative, by stealing from the tissues elements which are necessary to their development? Or have they a power of elaborating (or secreting) new products, which exert a toxic influence on the affected body? This last view is supported by weighty evidence and by the analogy of the fermentation processes already referred to. It would therefore seem that the microbe has the power of disturbing—or rather that, in order to the preservation of its own life, the microbe is compelled to disturb—the molecular arrangement of the elements in the medium in which it is developing. The products thus elaborated have been termed Ptomaines (*Ptōma*). They were so named by Selmi, who discovered their presence in the dead body during various stages of putrefaction. The ptomaine doctrine has been accepted in explanation of the process of septicæmia, and there is good reason for extending its application to the other infective processes. It is essential, however, to remember that, after the microbe has succeeded in invading the tissues, its further progress is not unopposed. There is a constant warfare between the living cells of the host and the living and multiplying cells of the invader, the contest being decided in favour of the stronger. The researches of Metschnikoff and others seem to show that the bacilli can be destroyed by the white corpuscles of the blood.

Granted that the organisms have entered the tissues or circulation, there still remain for the physician two modes of attack: (*a*) by attempting to exterminate the microbe itself through such agents as may be discovered to be possessed of germicidal properties; (*b*) by [illegible] gonise the poison which the [illegible] through the system. Many [illegible] methods, inasmuch as agents sufficiently potent to effect either object are themselves likely to prove injurious to the infected tissues. The aim of *curative* medicine is the discovery of remedies capable of preventing the growth of the microbe, yet innocuous to the host.

Reference must be made, in conclusion, to the question of immunity. It is well ascertained that certain animals are not susceptible to the attacks of certain patl [illegible] that others suffer compara [illegible] there may be traced the [illegible] immunity. Such facts have not yet received a satisfactory explanation. The almost universal immunity after a first attack of certain fevers and the comparative immunity from smallpox conferred by Vaccination (q.v.) are of interest in this connection. The experiments of Pasteur and others on *Bacillus anthracis* indicate that by repeated cultivation under special conditions it is possible to lessen the virulence of the most virulent of organisms and that inoculation with this altered bacillus confers immunity against further attack. More striking still are the experiments of Pasteur in connection with rabies (Hydrophobia, q.v.). By a special method that observer has accomplished an attenuation of the virus—the microbe not having been determined—whereby the worst features of the disease are disturbed. By this means it has been found possible in cases of infection to anticipate a serious attack by the introduction of this modified virus. In explanation of this it has been supposed that a poisonous ptomaine is germinated during the process, which, when injected in quantity during the stage of incubation of the disease, prevents the development of the supposititious germ. Those and other kindred observations disclose a most hopeful development of the germ theory in the direction of preventive inoculation.

The literature is a very large one. For general purposes the following may be consulted: Tyndall, *Essays on the Floating Matter of the Air;* Watson Cheyne, *Antiseptic Surgery;* Pasteur, *Studies on Fermentation;* Duclaux, *Ferments et Maladies;* Flügge, *Fermente und Mikroparasiten;* Schützenberger, *Les Fermentations;* Gussenbauer, *Pyo-hämie und Pyo-Sephthämie;* and the works of Lister, Klein, &c.

German Barm. See YEAST.

German Catholics (Ger. *Deutschkatholiken*) is the name given to a body in Germany that

separated from the Roman Catholic Church in 1844. Whatever might be the deeper causes of the schism, the immediate occasion of it was the exhibition of the Holy Coat at Treves (q.v.). In 1844 Bishop Arnoldi appointe[illegible] this relic. This proceeding [illegible] Johannes Ronge (1813–87), [illegible]o, having quarrelled with the authorities of his church, had been suspended. Ronge addressed a public letter to Bishop Arnoldi in which he characterised the exhibition of the coat as idolatry. A short time previously, Czerski, a priest at Schneidemühl, in Posen, had seceded from the Roman Catholic Church, and had formed a congregation of 'Christian Apostolic Catholics.' Czerski and Ronge were naturally drawn into confederacy. Ronge addressed an appeal to the lower orders of the priesthood, calling upon them to use their influence in the pulpit and everywhere to break the power of the papal curia, and of priestcraft in general, throughout Germany; to set up a national German Church independent of Rome, and governed by councils and synods; to abolish auricular confession, the Latin mass, and the celibacy of the priests; and to aim at liberty of conscience for all Christians.

The first congregation of the new church was formed at Schneidemühl, and took the name of 'Christian Catholic.' The confession of faith, which was drawn up by Czerski, differed little in point of doctrine from that of the Catholic Church. The confession drawn up by Ronge for the congregation at Breslau, on the other hand, completely departed from the doctrine and ritual of the Roman Catholic Church. The Scripture was laid down to be the sole rule of Christian faith, and no external authority was to be allowed to interfere with the free interpretation of it. The essentials of belief were restricted to a few doctrines: belief in God as the Creator and Governor of the world, and the Father of all men; in Christ as the Saviour, in the Holy Spirit, the holy Christian church, the forgiveness of sins, and the life everlasting. Baptism and the Lord's Supper were held to be the only sacraments, though confirmation was retained. At the first council of German Catholics, held at Leipzig in 1845, the principles of the Breslau Confession were substantially adopted; and by the end of the year there were some 300 congregations.

But German Catholicism was destined soon to find enemies both within and without. To say nothing of orthodox Catholics, conservative Protestantism began to suspect it as undermining religion. And, as the movement fell in with the liberal tendencies of the times, the governments took the alarm, and set themselves to check its spread. Saxony took the lead, and Prussia soon followed, in imposing vexatious restrictions upon the 'Dissidents;' in Baden they were denied the rights of citizens, while Austria expelled them from her territories. It was more, however, internal disagreements than state persecutions that checked the prosperity of German Catholicism. Czerski and his adherents held closely by the doctrines and ritual of Rome; while Ronge's party approached nearer and nearer to the extreme Rationalists, and, leaving the province of religion altogether, occupied themselves with freethinking theories and democratic politics. When the great storm of 1848 burst, Ronge was active in travelling and preaching, and, although his freethinking and political tendencies were repudiated by numbers of the body, they predominated in many places. After the political reaction set in, strong measures were taken against the German Catholics. The early enthusiasm of the movement apparently died out, and after the dissolution of the Frankfort parliament Ronge retired to London (in 1861 he returned to Germany, and lived successively at Breslau, Frankfort, Darmstadt, and Vienna). In 1850 a conference was held between the German Catholics and the 'Free Congregations' (*Freie Gemeinden*), an association of freethinking congregations which had been gradually forming since 1844 by secession from the Protestant Church, and with which an incorporate union was effected in 1859. Six years later the council refused to commit itself to belief in a personal God. From a membership of 13,000 in 1867 in Prussia and Saxony, the body has gradually dwindled to almost total extinction. The Old Catholics (q.v.) may be regarded as having superseded the German Catholic movement. See Kampe's *Geschichte des Deutsch-katholicismus* (1860).

German, Cousin-. See COUSIN.

Germander (*Teucrium*), a large and widely distributed genus of labiate herbs, of which all the European species are of old medicinal repute on account of their aromatic, bitter, and stomachic properties. The species are numerous. The Wall Germander or True Germander (*T. chamædrys*), often found on ruined walls, has probably been introduced from the south of Europe. With the German *T. Botrys*, it enjoyed a high reputation in the treatment of gout. Wood Germander or Wood Sage (*T. Scorodonia*) is a very common British plant, in dry bushy or rocky places. It is very bitter and slightly aromatic. It is used in Jersey as a substitute for hops. Water Germander (*T. Scordium*), in wet meadows, has a smell like garlic. Cat or Sea Thyme (*T. Marum*), of southern Europe, like catmint and valerian root, has great attractiveness for cats. It is still sometimes used in the preparation of sneezing powders.

Germanicus Cæsar, a distinguished Roman general, was the son of Nero Claudius Drusus, and of Antonia, daughter of Mark Antony and niece of Augustus. He was born 15 B.C., and by desire of Augustus was adopted in the year 4 A.D. by Tiberius, whom he accompanied in the war against the Pannonians, Dalmatians, and Germans. In the year 12 he was consul, and next year was appointed to the command of the eight legions on the Rhine. In 14 he was at Lugdunum Batavorum when news came of the death of the Emperor Augustus and of the mutiny for more pay and shorter service among the soldiers in Germany and Illyricum. Germanicus hastened to the camp and quelled the tumult by his personal popularity; and at once led his soldiers against the enemy. Crossing the Rhine below Wesel, he attacked and routed the Marsi, and next year marched to meet the redoubtable Arminius (q.v.), the conqueror of Varus and his legionaries, whose bones had lain whitening for six years in the Teutoburg Forest. With solemn rites his soldiers buried these sad relics of disaster, then advanced against the foe, who, retiring into a difficult country, managed to save himself, and was not subdued until the year after, when Germanicus again carried a part of his army up the Ems in ships, crossed to the Weser, and completely overthrew Arminius in two desperate battles. The victories thus achieved were to have been followed up in the succeeding years, but Tiberius, jealous of the glory and popularity of Germanicus, recalled him from Germany in the year 17, and sent him to settle affairs in the East, at the same time appointing as viceroy of Syria, in order secretly to counteract him, the haughty and envious Cn. Calpurnius Piso. Germanicus died at Epidaphnæ, near Antioch, 9th October 19, probably of poison, to the profound sorrow of provincials and Romans alike. His wife, Agrippina, and two of her sons were put to death by order of Tiberius; the third son, Caligula, was spared. Of the three daughters who survived their father, Agrippina became as remarkable for her

vices as her mother had been for her virtues. Germanicus is one of the most attractive heroes of Roman history. The courage and success of the soldiership that had blotted out a great national disgrace, the [illegible] of his private character, the [illegible] of his life, and the shadow of impending death that touched him with romantic interest, combined to make him the darling of his contemporaries, and has left him, as portrayed in the pages of Tacitus (*Annals*, i. and ii.), still a figure of unique interest to us.

Germanium, a metallic element discovered in 1885 by Dr Winkler in a silver ore (argyrodite); symbol, Ge; atomic weight, 72·3. It has a melting-point about 1650° F. (900° C.); is oxidised when heated in air; crystallises in octahedra; has a perfectly metallic lustre, and is of a grayish-white colour. As gallium had been named from France, the new metal was named after Germany. Fifteen years before its discovery its existence was prophesied by Mendeleëff as required to fill the gap in the periodic table between silicon and tin. See ATOMIC THEORY.

German Ocean. See NORTH SEA.

German Silver. This is a triple alloy of copper, nickel, and zinc, and is sometimes called nickel silver. The best quality of it consists of four parts copper, two parts nickel, and two parts zinc, but this quality is the most difficult to work. For some purposes the proportion of copper is slightly increased, and for articles which are to be cast instead of stamped or hammered about 2 per cent. of lead is added. To make a good malleable alloy, the three metals of which it is composed should all be of the best quality. German silver has a tendency to crack in Annealing (q.v.), and is all the more liable to do this if its component metals are impure. Its crystalline structure is got rid of by hammering, rolling, and annealing. It is harder and tougher than brass, and takes a fine polish. In colour it is sufficiently near silver to make it valuable for plating with that metal. This, together with its hardness in resisting wear, has caused a great demand for German silver for certain wares made in Birmingham and Sheffield.

Spoons and forks of this alloy are made in immense numbers. Such articles as salvers, dish-covers, jugs, teapots, and the like are also largely made of it, but these objects, or at least some of them, are still more largely made of Britannia Metal (q.v.), a greatly inferior alloy, because much softer. German silver has a coppery odour, and is readily attacked by acid liquids, such as vinegar, which coat it with verdigris. Spoons and forks made of this alloy should therefore either be plated with silver or carefully kept clean.

Of late years, through care in preparing a suitable alloy, large objects, such as the bodies of jugs and coffee-pots, can be formed of sheet German silver by 'spinning' it on the lathe, instead of by stamping or by the slow process of hammering. Formerly it was only a soft alloy like Britannia metal that could be so treated. For some time past there has been a tendency to substitute for electroplate—i.e. German silver plated with real silver—white alloys having nickel for their basis. These, however, are but varieties of German silver known under different names, such as silveroid, argentoid, navoline, and nickeline. Some of them contain small quantities of tin, cadmium, and other metals. Mountings for ship-cabins, bar-fittings, and also forks and spoons have been manufactured on a considerable scale from these new alloys.

German Tinder. See AMADOU.

Germantown, a former borough of Pennsylvania, included since 1854 in the limits of Philadelphia. Here an attack by Washington on the British camp, in the early morning of 4th October 1777, was repulsed, the Americans losing 1000 men, the British 600.

Germanus, ST, was Bishop of Auxerre, and is said to have been invited over to Britain to combat Pelagianism in 429. Acting under his directions the Christian Britons won the bloodless 'Alleluia Victory' over the Picts and Saxons. In 1736 a column was erected on the supposed site, Maes Garmon (Germanus' field), in Flintshire. There are several churches in Wales and Cornwall dedicated to St Germanus.

Germany (from Lat. *Germania*) is the English name of the country which the natives call Deutschland, and the French L'Allemagne (see ALEMANNI). The word is sometimes used to denote the whole area of the European continent within which the Germanic race and language are dominant. In this broad sense it includes, besides Germany proper, parts of Austria, Switzerland, and perhaps even of the Netherlands; but in the present article the name is to be understood as denoting the existing Germanic empire, of which Prussia is the head. Germany occupies the central portions of Europe, and extends from 5° 52′ to 22° 53′ E. long., and from 47° 16′ to 55° 54′ N. lat. It is bounded on the N. by the German Ocean, the Danish peninsula, and the Baltic; on the E. by Russia and Austria; on the S. by Austria and Switzerland; and on the W. by France, Belgium, and the Netherlands. The population in 1871 was 41,058,792; in 1880, 45,234,061; in 1885, 46,855,704. Its area is 211,168 sq. m., or about $\frac{1}{16}$th of that of all Europe—slightly larger than France, but not twice as large as Great Britain and Ireland. The coast-line measures about 950 miles.

Germany is composed of a federation of twenty-five states, with one common imperial province, the names of which, with their areas and populations in 1885, are given in the following list. They are elsewhere treated of in special articles, under their respective names.

States.	Area in sq. m.	Pop. in 1885.
KINGDOMS—		
1. Prussia	136,073	28,318,470
2. Bavaria	29,632	5,420,199
3. Saxony	5,856	3,182,003
4. Würtemberg	7,619	1,995,185
GRAND-DUCHIES—		
5. Baden	5,891	1,601,255
6. Hesse	3,000	956,611
7. Mecklenburg-Schwerin	5,197	575,152
8. Saxe-Weimar	1,404	313,946
9. Mecklenburg-Strelitz	1,144	98,371
10. Oldenburg	2,508	341,525
DUCHIES—		
11. Brunswick	1,441	372,452
12. Saxe-Meiningen	964	214,884
13. Saxe-Altenburg	517	161,460
14. Saxe-Coburg-Gotha	765	198,829
15. Anhalt	917	248,166
PRINCIPALITIES—		
16. Schwarzburg-Sondershausen	337	73,606
17. Schwarzburg-Rudolstadt	367	83,836
18. Waldeck	438	56,575
19. Reuss-Greiz	123	55,904
20. Reuss-Schleiz	323	110,598
21. Schaumburg-Lippe	133	37,204
22. Lippe-Detmold	475	123,212
FREE-TOWNS—		
23. Lübeck	116	67,658
24. Bremen	100	165,628
25. Hamburg	160	518,620
REICHSLAND—		
26. Alsace-Lorraine	5,668	1,564,355
	211,168	46,855,704

These several sovereign states vary enormously in area and influence. Thus, while Prussia alone exceeds the British Islands in area, Bavaria is almost as large as Scotland, Würtemberg is larger

than Wales, and Baden and Saxony are neither of them equal to Yorkshire. Waldeck is about equal to Bedford, and Reuss-Greiz is smaller than Rutland, the smallest English county. The Duke of Sutherland's estates (1838 sq. m.) are larger in area than all Mecklenburg-Strelitz, or than all Brunswick, respectively tenth and ninth in size of the German states. The Duke of Buccleuch's Scottish estates alone (676 sq. m.) exceed in area Saxe-Altenburg or any of the eleven smaller states.

In 1885 Berlin, the capital of the empire, had 1,315,287 inhabitants; Hamburg, 305,690; Breslau, 299,640; Munich, 261,981; Dresden, 246,086; Leipzig, 170,340. There were in all 21 towns with a population of above 100,000; 116 between 20,000 and 100,000; 683 between 5000 and 20,000; and 1951 between 2000 and 5000.

Besides the political divisions above mentioned, there are certain distinctive appellations applied to different parts of Germany, which have been derived either from the names and settlements of the ancient Germanic tribes, or from the circles and other great subdivisions of the old empire. Thus, the name of 'Swabia' is still applied in common parlance to the districts embracing the greater part of Würtemberg, southern Baden, south-western Bavaria, and Hohenzollern; 'Franconia,' to the Main districts of Bamberg, Schweinfurt, and Würzburg; 'the Palatinate,' to Rhenish Bavaria and the north of Baden; 'the Rhineland,' to portions of Baden, Rhenish Prussia, Bavaria, Hesse-Darmstadt, and Nassau; 'Voigtland,' to the high ground between Hof and Plauen; 'Thuringia,' to the districts lying between the Upper Saale and the Werra, as Saxe-Weimar, &c.; 'Lusatia,' to the eastern part of Saxony; 'East Friesland,' to the country between the Lower Weser and Ems; and 'Westphalia,' to the district extending between Lower Saxony, the Netherlands, Thuringia, and Hesse, to the German Ocean. The four Saxon duchies and the four Schwarzburg and Reuss principalities are frequently grouped together as the 'Thuringian States.'

Physical Character.—Germany presents two very distinct physical formations. (1) A range of high tableland, occupying the centre and southern parts of the country, interspersed with numerous ranges and groups of mountains, the most important of which are the Harz and Teutoburgerwald, in the north; the Taunus, Thüringerwald, Erzgebirge, and Riesengebirge, in the middle; and the Black Forest (Schwarzwald), Rauhe Alb, and Bavarian Alps in the south; and containing an area, including Alsace and Lorraine, of 110,000 sq. m. The Brocken is 3740 feet high; the Vosges reach 4700; the Feldberg in the Black Forest is 4903; and the Zugspitz in the Noric Alps of Bavaria, the highest peak in Germany, is 9665 feet in height. (2) A vast sandy plain, which extends from the centre of the empire north to the German Ocean, and including Sleswick-Holstein, contains an area of about 98,000 sq. m. This great plain, stretching from the Russian frontier on the east to the Netherlands on the west, is varied by two terrace-like elevations. The one stretches from the Vistula into Mecklenburg, at no great distance from the coast of the Baltic, and has a mean elevation of 500 to 600 feet, rising in one point near Danzig to 1020 feet; the other line of elevations begins in Silesia and terminates in the moorlands of Lüneburg in Hanover, its course being marked by several summits from 500 to 800 feet in height. A large portion of the plain is occupied by sandy tracts interspersed with deposits of peat; but other parts are moderately fertile, and admit of successful cultivation.

The surface of Germany may be regarded as belonging to three drainage basins. The Danube (q.v.) from its source in the Black Forest to the borders of Austria belongs to Germany; and through its channel the waters of the greater part of Bavaria are poured into the Black Sea. Its chief tributaries are the Iller, Lech, Isar, and Inn on the right; and the Altmühl, Nab, and Regen on the left. By far the greater part of the surface (about 185,000 sq. m.) has a northern slope, and belongs partly to the basin of the North Sea, partly to that of the Baltic. The chief German streams flowing into the North Sea are the Rhine (q.v.), with its tributaries the Neckar, Main, Lahn, Sieg, Wupper, Ruhr, and Lippe on the right, and the Ill and Moselle on the left; the Weser (q.v.), with its tributary the Aller; and the Elbe (q.v.), with its tributaries the Havel, Mulde, and Saale. Into the Baltic flow the Oder (q.v.), with its tributaries the Warthe, Neisse, and Bober; the Vistula (q.v.), or in German Weichsel, with its tributaries the Narew, Drewenz, and Brahe; the Memel; and the Pregel.

The natural and artificial waterways of Germany are extensive, especially in the northern plain. The most important of the numerous canals which connect the great river-systems of Germany are Ludwig's Canal (110 miles long) in Bavaria, which, by uniting the Danube and Main, opens a communication between the Black Sea and the German Ocean; the Finow (40 miles) and Friedrich-Wilhelm's (20 miles) canals in Brandenburg; the Plaue Canal (20 miles), between the Elbe and the Havel; the Kiel and Eider Canal (21 miles), uniting the Baltic and German Ocean; and the canals between the Oder and Vistula, Rhine and Rhone (225 miles), and Rhine, Marne, and Seine (165 miles). The North Sea and Baltic Canal, from Brunsbüttel at the mouth of the Elbe to Kiel, begun in 1887 and to be finished in 1895, is intended chiefly for warships. Numerous lakes occur both in the tableland of southern Germany (Bavaria) and in the low lands of the northern districts, but few of them are of any great size. The so-called 'Haffs' of the north coasts are extensive bays of the sea, but so curiously landlocked as to practically form huge salt-water lagoons or coast-lakes. The chief are the Stettiner Haff, the Frische Haff at Königsberg, and the Kurische Haff at Memel. Germany abounds in swamps and marsh-lands, which are especially numerous in the low northern districts. Its mineral springs occur principally in Nassau, Würtemberg, Baden, Bavaria, and Rhenish Prussia. Many of these springs have retained their high reputation from the earliest ages.

Geology.—The great plain of North Germany consists of strata of the same age as the Tertiary strata of the Paris basin, covered with very recent sand and mud. Newer Tertiary beds occupy the river-basin of the Rhine north from Mainz; they consist of fine light-coloured loam, and contain the bones of the mammoth, rhinoceros, and other contemporaneous mammals. Erratics are scattered over the north of Germany. The whole district in the centre of Germany, from the Danube northwards to Hanover, consists of Secondary strata. The rocks of the Trias period are best known in Germany, the typical rocks of Bunter Sandstein, Muschelkalk, and Keuper being developed here so as to justify the name Trias. The Trias is highly fossiliferous, abounding especially in marine shells, and containing several genera of remarkable labyrinthodont saurians. Jurassic rocks occur in central Germany; at Hanover they consist of clays and marl, with beds of sandstone and limestone, containing coal and ironstone of such value that they have been extensively wrought. Intruded igneous rocks have tilted the beds of the Cretaceous strata in some districts to a nearly vertical position, and have metamorphosed them into crystalline marbles and siliceous sandstones.

Of the Palæozoic rocks, the Carboniferous strata are almost entirely absent from Germany. The

coal obtained in the country is from rocks of a later age. True coal-beds are found in Rhenish Prussia. The sedimentary rocks of the Harz Mountains are chiefly Devonian; to the south-east, near Harzgerode, they are Upper Silurian. They are all greatly dislocated by granite and other intrusive rocks. The Harz Mountains are surrounded by a zone of Permian rocks. The stratified rocks of the Thüringerwald are also Devonian, resting on Lower Silurian strata, the lower portion of which is highly metamorphosed into quartzose schists; the remainder consists of graywacke, slate, and sandstone, with limestone and alum slates. There are numerous fucoid and annelid impressions in the older beds, and graptolites, orthoceratites, and trilobites in the newer. The basaltic rocks, trachytes, and other volcanic products are largely developed in the Eifel, Siebengebirge, Westerwald, Vogels, Rhöngebirge, and other mountain-systems of central Germany.

Climate.—The climate of Germany presents less diversity than a first glance at the map might lead one to infer, for the greater heats of the more southern latitudes are considerably modified by the hilly character of the country in those parallels, while the cold of the northern plains is mitigated by their vicinity to the ocean. The average decrease in the mean temperature is, in going from south to north, about 1° F. for every 52 miles; and in going from west to east, about 1° F. for every 72 miles. The line of perpetual snow varies from 7200 to 8000 feet above the level of the sea. The mean annual rainfall is 20 inches. The rainfall is heaviest on the coast and in the mountains; least in Silesia, on the Danube at Sigmaringen, in Rhenish Bavaria, and at Wustrow in Mecklenburg. The rainfall in the Upper Harz reaches 66 inches. The difference between the greatest heat and the greatest cold in Germany is about 130° F. January is the coldest and July the warmest month. The following table shows the mean annual records of the temperature at different points of the continent:

	Annual mean.	Summer.	Winter.
Hamburg	47° F.	64° F.	30° F.
Dresden	48	67	29
Frankfort-on-the-Main	48·5	66	31
Berlin	46·5	66	27
Hanover	48	63	33
Königsberg	43	62	24

Products.—The mineral products of Germany are very rich and varied, and their exploitation forms a most important industry. The chief mining and smelting districts are in Silesia, on the Lower Rhine, in the Upper Harz, and in Saxony. Silver is found in the Upper Harz and Saxony. Iron occurs in numerous mountain-ranges, especially in Upper Silesia and in Rhenish Westphalia. Alsace and Lorraine contain a great part of perhaps the largest iron-deposit in Europe, which stretches into France and Luxemburg. The iron of the Thüringerwald is fine, though not abundant. The chief coalfields are in Silesia, Westphalia (on the Ruhr), and Saxony—the first containing the largest coalfield in Europe. Prussia yields nearly one-half of the zinc annually produced in the world. Lead is found in the Harz, in other parts of Prussia, and in Saxony. A little copper is mined at Mansfeld. Tin and tungsten are yielded by the Erzgebirge; manganese at Wiesbaden; quicksilver in Westphalia; antimony in Thuringia. Salt is produced at Halle, Stassfürt, and other parts of Prussia. Germany is rich in clays of all kinds, from the finest to the coarsest: the porcelain of Meissen, the pottery of Thuringia, and the glass of Silesia and Bavaria are celebrated. Building stone is well distributed; marble, alabaster, slates, and lithographic stones also occur; and cobalt, arsenic, sulphur, saltpetre, alum, gypsum, bismuth, pumice-stone, Tripoli slate, kaolin, emery, ochre, and vitriol are all among the exports of Germany. The following table shows the production of the five years 1882–86, with the yearly average, and the produce and value for 1887, of the chief minerals of Germany (including the duchy of Luxemburg):

	1882-1886. tons.	Yearly Average. tons.	Produce in 1887. tons.	Value in 1887.
Anthracite	281,672,500	56,334,500	60,334,000	115,553,850
Lignite	73,620,300	14,724,060	15,898,600	2,010,050
Salt	7,051,700	1,410,340	1,485,500	735,400
Iron ore	43,669,300	8,733,860	9,351,100	1,700,250
Zinc ore	3,390,300	678,060	900,700	501,100
Lead ore	826,700	165,340	157,600	796,150
Copper ore	2,890,100	578,020	507,600	727,600
Gold and silver ore	119,300	23,860	25,700	208,900
Vitriol, &c.	748,400	149,680	101,700	38,800
Other minerals	369,000	73,800	110,500	168,200
Total	414,357,600	82,871,520	88,873,000	£122,440,300

The vegetable products comprise a very large proportion of the European flora. All the ordinary cereals are extensively cultivated in the north, but in 1888 the value of the wheat, barley, oats, and rye imported exceeded the value of that exported by £2,261,700. The export of potatoes exceeded the import by £423,400. Hemp and flax, madder, woad, and saffron grow well in the central districts, where the vine, the cultivation of which extends in suitable localities as far north as 51°, is brought to great perfection. The best wine-producing districts are the valleys of the Danube, Rhine, Main, Neckar, and Moselle, which are, moreover, generally noted for the excellence of their fruits and vegetables. The best tobacco is grown on the Upper Rhine, on the Neckar, and in Alsace, but inferior qualities are largely produced elsewhere. The hops of Bavaria have a high reputation, and the chicory grown in that country, and in the district between the Elbe and Weser, is used all over Europe as a substitute for coffee. Magdeburg is the centre of a large beetroot-growing industry. According to the survey of 1883, corrected for 1887, 48·7 per cent. (65,779,920 acres) of the entire area of the empire was given up to arable land, garden-land, and vineyards. Anhalt had the highest proportion of such land; and, excluding the domains of the free towns, Oldenburg had the lowest. About 20·3 per cent. (27,361,428 acres) was occupied by heath, meadow, and pasture, Oldenburg containing the greatest proportion, and Saxe-Coburg-Gotha the lowest. The chief crops in 1887 were meadow-hay, 14,778,650 acres; rye, 14,605,700 acres; oats, 9,525,610 acres; potatoes, 7,295,368 acres; wheat, 4,799,200 acres; barley, 4,327,800 acres; and spelt, 926,790 acres. In 1887–88 tobacco occupied 53,665 acres; in 1881–82, 68,120 acres. Vines covered 300,525 acres in 1887–88, and yielded 52,624,924 gallons of wine. The most extensive forests are found in central Germany, while the deficiency of wood in the north-west parts of the great plain is in some degree met by the abundance of turf. Germany in 1883 had 34,770,995 acres (25·7 per cent. of its area) in woods and forest. Schwarzburg-Rudolstadt had the highest proportion of area devoted to forest; and, excluding the free-towns, Oldenburg had the lowest. The largest forests are of firs and red pines (as in the Black Forest, Upper Harz, Thüringerwald, and Riesengebirge), beech (Lower Harz and Baltic coast), pines (east of Elbe, Bavaria, Franconia, and on the Rhine), and oaks (Lower Rhine, Westphalia, Odenwald, and Upper Silesia).

Germany has long been noted for the good breed of horses raised in the north; Saxony, Silesia, and Brandenburg have an equal reputation for their sheep and the fine quality of the wool which they yield; and the rich alluvial flats of Mecklenburg

and Hanover are celebrated for their cattle. The forests of northern and central Germany abound in small game of various kinds; and a few still shelter wild boars. The Bavarian Alps afford shelter to the larger animals, as the chamois, the red deer and wild goat, the fox and marten. Wolves are still found in Bavaria, the eastern provinces of Prussia, and in Lorraine. The bear is now extinct, and the beaver nearly so. In all the plains in the north storks, wild geese, and ducks are abundant. Among the fishes of Germany the most generally distributed are carp, salmon, trout, and eels; the rivers contain also crayfish, pearl-bearing mussels, and leeches. The oyster, herring, and cod fisheries constitute important branches of industry on the German shores of the Baltic and North Sea. Germany stands next to Great Britain in regard to the care and success with which its agricultural, mining, and other natural capabilities have been cultivated. All the German states, and especially Prussia, Saxony, and Bavaria, encourage agriculture, and have endeavoured, by the establishment of agricultural colleges and exhibitions, to diffuse among the people a knowledge of recent scientific appliances. Forestry receives almost as much attention in Germany as agriculture; and, like the latter, is elevated to the rank of a science. The larger woods and forests in most of the states belong to the government, and are under the care of special boards of management, which exercise the right of supervision and control over all forest lands, whether public or private.

Manufactures.—The oldest and most important of the German industrial arts are the manufactures of linen and woollen goods. The chief localities for the cultivation and preparation of flax, and the weaving of linen fabrics, are the mountain-valleys of Silesia, Lusatia, Westphalia, and Saxony (for thread-laces); while cotton fabrics are principally made in Rhenish Prussia and Saxony. The same districts, together with Pomerania, Bavaria, Alsace, Würtemberg, and Baden, manufacture the choicest woollen fabrics, including damasks and carpets. The silk industry has its central point in Rhenish Prussia, with a special development in the district of Düsseldorf. Germany rivals France more keenly in the production of satins than in that of heavier all-silk goods. Jute-spinning is carried on in Brunswick, at Meissen, and at Bonn; thread is manufactured in Saxony, Silesia, and the Rhine provinces; and hosiery is most largely produced in Saxony and Thuringia. The making of toys and wooden clocks, and wood-carving, which may be regarded as almost a speciality of German industry, flourish in the hilly districts of Saxony, Bavaria, and the Black Forest. Paper is made chiefly in the districts of Aix-la-Chapelle, Arnsberg, and Liegnitz, and in Saxony. Tanning, especially in the south-west, is an ancient German industry. The best iron and steel manufactures belong to Silesia, Hanover, and Saxony; in 1887, 4,024,000 tons of iron, representing a value of £8,322,150, were handled in the foundries of Germany. Silesia probably possesses the finest glass-manufactories, but those of Bavaria are also important; while Saxony and Prussia stand pre-eminent for the excellence of their china and earthenware. Augsburg and Nuremberg dispute with Munich and Berlin the title to pre-eminence in silver, gold, and jewelry work, and in the manufacture of philosophical and musical instruments; while Leipzig and Munich claim the first rank for typefounding, printing, and lithography. The trading cities of northern Germany nearly monopolise the entire business connected with the preparation of tobacco, snuff, &c., the distillation of spirits from the potato and other roots, and the manufacture of beet-root sugar; while vinegar and oils are prepared almost exclusively in central and southern Germany. In 1885–86, 918,948,000 gallons of beer were brewed in the German empire, the chief producing states being Prussia (477,138,200 gals.) and Bavaria (278,645,400 gals.). The annual consumption per head of the population is 19·3 gallons. According to the industrial census of 1882, the number of persons in Germany engaged in manufactures and commerce was 7,966,783. The following figures, showing the distribution of that total, afford a view of the comparative importance of the various industries: Clothing, washing, &c., 1,334,007; building and related industries, 946,583; retail trading, 853,827; textile industries, 850,859; metal-working, carriage and ship building, &c., 813,906; preparation of food and food-materials, 663,226; mining (including founding and salt-winning), 552,020; workers in wood and wicker, 521,660; postal service, transport, &c., 437,040; lodging and refreshment, 279,451; industries in stone, earth, clay, 221,006; paper and leather working, 220,039; chemicals and lighting materials, 88,397; printing, &c., 69,643; art industries, 23,893; miscellaneous, 91,226. Besides these, 8,065,350 were engaged in agriculture, 91,630 in forestry and hunting, 55,168 in horticulture, and 24,348 in fishing.

Commerce and Shipping.—The multiplicity of small states into which the German land was long broken up opposed great obstacles to the development of commerce; but the difficulty was to some extent obviated by the establishment of the Zollverein (q.v.), or Customs and Trade Confederation, and partly also by the absorption of several of the smaller states by Prussia. In 1871 a *Zollund Handels-Gebiet* (Customs and Trade Territory) was formed in Germany, including Luxemburg (1010 sq. m.; 213,283 inhabitants in 1885) and the Austrian district of Jungholz (212 inhabitants), but excluding Hamburg, Bremen, and parts of Oldenburg, Prussia, and Baden (together 140 sq. m.; 754,705 inhabitants). On October 15, 1888, however, all these districts entered the union, with the exception of the Baden territory (4054 inhabitants), and part of the old free-port of Hamburg (152 inhabitants). The old Zollverein parliament is represented by the Reichstag, and the Zollverein council by the Bundesrath, which appoints three permanent committees—for finance, for excise and customs, and for trade. The revenues of the union are derived from customs duties upon imports, and from excise duties on tobacco, salt, beetroot-sugar, brandy, malt, &c., and are divided among the different states according to the populations.

The following table shows the exports of home produce and the imports for home consumption in 1888, for the customs union as constituted before October of that year:

Official Class.		Exports.	Imports.
1. Living animals		£4,725,350	£7,783,200
2. Seeds and plants		1,308,900	2,129,800
3. Animal products		1,057,550	4,051,100
4. Fuel		5,754,950	3,550,440
5. Food-stuffs		19,569,450	37,561,870
6. Tallow, oils, &c.	Raw materials and manufactured goods	1,330,000	10,763,950
7. Chemicals and drugs		11,805,450	12,142,250
8. Stone, clay, and glass		5,870,450	2,559,750
9. Metals and metal goods		24,334,950	15,857,500
10. Wood and wickerwork		5,650,400	8,631,800
11. Paper		4,731,550	711,200
12. Leather and hides		11,846,100	8,369,050
13. Textiles and felt		53,761,950	51,271,250
14. Caoutchouc		1,252,300	1,459,100
15. Carriages, furniture, &c.		142,250	25,200
16. Machinery and instruments		6,667,100	2,472,500
17. Hardware, toys, &c.		4,265,450	1,270,800
18. Literature, art, &c.		3,610,800	1,514,650
19. Miscellaneous		33,050	..
Total		£167,730,100	£171,703,850

These totals, which include the returns of gold and silver, show a considerable increase on the annual average for the five preceding years (1883–87), which was for exports, £157,612,750; for imports, £156,994,450. Taking into account the general commerce also, the total value of imports in 1888 was £257,690,300; of exports, £247,739,400. Great Britain, Russia, Austria, Belgium, the Netherlands, and France contributed more of the German imports than any other countries; Great Britain, Austria, the Netherlands, and France took more of the exports. German foreign trade has expanded since 1871, as is shown by the fact that, whereas the exports from Germany to Great Britain had in 1871 a value of £19,263,319, in 1887 the value was £24,563,536.

The German mercantile fleet is the fourth in the world, being excelled only by those of Great Britain, the United States, and France. In 1889 it consisted of 2885 sailing-ships, of 731,315 tons burden, and 750 steamers, of 502,579 tons; making a total of 3635 vessels, of 1,233,894 tons, with 36,258 sailors. In 1871 there were 4519 vessels, of 982,355 tons. The leading ports are Hamburg, Bremerhaven (for Bremen), Stettin, Danzig, Kiel, Lübeck, and Königsberg. In 1887 there entered German ports 50,124 ships (9,840,927 tons) with lading, and 9768 (892,257 tons) empty or in ballast; and in the same year there cleared 45,076 ships (7,966,526 tons) with lading, and 14,769 (2,803,243 tons) empty or in ballast. Of the shipping entering 3,052,450 tons were British, and 699,000 tons Danish; 5,591,000 tons were German. Besides this maritime shipping trade, Germany carries on a very active commerce between its own internal ports, by means of 20,390 vessels (1153 steamers), plying on the numerous navigable rivers and canals.

In her commercial policy Germany has of late years committed herself more and more to protection; and by a law of July 1879 a protective policy was substituted for the previous free-trading principles of the empire. The chaos of coinages in use before the establishment of the empire has been rectified by the substitution (1873) of a uniform imperial system, the standard being gold (see BIMETALLISM). The silver mark, superseding guldens and thalers, is almost exactly equal to a shilling in value. Since 1872 the metrical system of weights and measures has been in use.

Railways, &c.—The first railway in Germany was the Ludwigsbahn between Nuremberg and Fürth, completed in 1835; but the first of any length was built between Leipzig and Dresden in 1837–39. In 1887–88 the railways in Germany had a total length of 24,706 English miles. Of that total 21,268 miles were state lines, 263 miles were private lines under state management, and 3175 miles were private lines under private management.

The postal and telegraphic systems of all the German states, except Bavaria and Würtemberg, are now under a central imperial administration; and since 1872, in accordance with treaties concluded between Austria and Prussia, a German-Austrian postal union has been established. The postal system includes the expedition of passengers and goods by the post-carriages of the several departments. In 1887 there were 19,476 post-offices in the empire, and 14,990 telegraph-offices. The total length of telegraph lines at the end of 1887 was 55,748 miles, with 198,214 miles of wire. This double department employed 101,208 hands. In 1887–88 its income was £10,672,322, and its expenditure £9,157,247.

Population, &c.—Four-fifths of the population of this country are of the race called in English Germans, in French Allemands, but by the people themselves Deutsche. The term Deutsch, in Gothic *thiudisk*, in Old High Ger. *diutisc* (Latinised into *theotiscus*), is derived from the Gothic substantive *thiuda*, 'people,' and therefore meant originally the popular language; or, in the mouth of the learned, the vulgar tongue. In the 12th and 13th centuries it became the accepted designation both of this widespread tongue and of the race that speak it.

The German-speaking inhabitants of the empire number upwards of 43,000,000; but a considerable proportion of these are not of the Germanic stock. Among the peoples retaining their own language (about 3¼ millions) are Poles (exclusively in eastern and north-eastern Prussia), 2,450,000; Wends (in Silesia, Brandenburg, and Saxony), 140,000; Czechs (in Silesia), 50,000; Lithuanians (in eastern Prussia), 150,000; Danes (in Sleswick), 140,000; French (in Rhenish Prussia, Alsace, and Lorraine) and Walloons (about Aix-la-Chapelle in Rhenish Prussia), 280,000. The Germans are divided into High and Low Germans; the language of the former is the cultivated language of all the German states; that of the latter, known as *Platt-Deutsch*, is spoken in the north and north-west. As to the colour of the hair, Professor Virchow caused observations to be made on the hair of 1,758,827 school children, four-fifths of the total number. The result showed that 31·80 per cent. belonged to the blonde type; 14·05 to the brunette type; and 54·15 to the intermediate type. The blondes were most numerous in North Germany, the brunettes in South Germany.

It is computed that there are 23,000,000 Germans beyond the boundary of the empire, of whom 9½ millions are in Austria, 7 in the United States, 2 in Switzerland, 400,000 in Poland (besides 800,000 German Jews). There are also many in the Volga country, in middle and south Russia, Roumania, and Turkey.

The average density of the population of Germany is about 222 per sq. m. The most densely populated country of the empire is Saxony, with 513 per sq. m.; the most sparsely populated is Mecklenburg-Strelitz, with 87 per sq. m. The concentration of the population in large towns is not so common in Germany as in some other countries. Although in 1885 there were 137 towns with 20,000 inhabitants and upwards, only one of these reached a million, three others 250,000 (see p. 172), and seventeen others 100,000; twenty-three had between 50,000 and 100,000.

Emigration.—During the last fifty years emigration from Germany has assumed very large proportions; but since 1881, when the highest total (220,798) was reached, the annual number of emigrants has greatly decreased. Between 1830 and 1887 it is calculated that about 4,200,000 emigrants left the country, five-sevenths of whom were bound for the United States of North America. The others went, in varying proportions, to South America, Australia, Canada, Africa, and Asia. In 1851–60 about 1,130,000 emigrants left Germany; in 1860–71, 970,000; in 1871–80, 595,150; and in 1881–88, 1,143,570. In 1886 the number was 83,218; in 1887, 103,055; and in 1888, 98,515, besides about 4000 sailing from French ports. By far the largest proportion of emigrants come from the northern parts of the empire: in 1888 the provinces of Posen and West Prussia each contributed over 12,000 to the Prussian total of 63,000. Bavaria sent 12,200; Würtemberg, 6500; Saxony, 2300. To balance this efflux of native blood, there were, in 1885, 372,792 foreigners in the German empire, of whom about 120,000 were Austrians. There were 11,155 British subjects in Germany in 1880.

Colonies.—The steady stream of emigration from Germany renders it natural that Germany

should wish to retain as many as possible of her emigrating children under her own flag; hence of late there has been much zeal in Germany for the extension of German territory abroad, and between 1884 and 1889 the following regions have become German possessions or come under German protection:

	Area in sq. miles.	Population.
I. Africa—		
Togoland, on the Slave Coast	400	40,000
Cameroon	115,000	200,000
Damaraland and Great Namaqualand	230,000	
Usagara, &c., in East Africa	60,000	
Wituland	520,000	
German Protectorate, agreed upon with Britain and Zanzibar	240,000	
II. Polynesia—		
In Marshall Islands	150	10,000
Kaiser Wilhelm Land, in New Guinea	70,300	100,000
Bismarck Archipelago (New Britain, &c.)	18,150	188,000
In Solomon Islands	8,500	80,000

Education.—Education is more generally diffused in Germany than in any other country of Europe, and is cultivated with an earnest and systematic devotion not met with to an equal extent among other nations. Besides the Academy at Münster (founded 1780; 476 students) and the small Lyceum at Braunsberg (1568), which have only the two faculties of Philosophy and Catholic Theology, there are 20 universities: Heidelberg (1386), Würzburg (1402), Leipzig (1409), Rostock (1419), Greifswald (1456), Freiburg (1457), Munich (1472), Tübingen (1477), Marburg (1527), Königsberg (1544), Jena (1557), Giessen (1607), Kiel (1665), Göttingen (1734), Erlangen (1743), Berlin (1809), Breslau (1811), Halle (1817), Bonn (1818), Strasburg (1872). These institutions embrace the four faculties of Theology, Law, Medicine, and Philosophy; in 1889 they had 2260 professors and teachers, and in 1888–89 (winter session) 28,550 students. Berlin (5790 students), Leipzig (3430), and Munich (3602) are the largest universities; Jena (463) and Rostock (346) the smallest. Of the universities, 14 are Protestant—i.e. in the department of theology they teach only Protestant theology; three are Roman Catholic—viz. Freiburg, Munich, and Würzburg; three—viz. Bonn, Breslau, and Tübingen—are mixed, Protestantism prevailing in the first two, and Roman Catholicism in the last. There are also 16 polytechnic institutions; 787 gymnasia, realschulen, &c.; numerous special schools of technology, agriculture, forestry, mining, commerce, military science, &c.; several seminaries for teachers, and for the ministers of different religious denominations; and nearly 60,000 elementary schools. The attendance of children at school, for at least four or five years, is made compulsory in nearly all the German states, and hence the proportion of persons who cannot read and write is exceedingly small. Among the military recruits of 1887–88 only 0·71 per cent. were unable either to read or write. In East Prussia the percentage was 4·16—the highest in the empire. In all the other states, except Mecklenburg-Schwerin (1·27), the number of illiterate recruits was less than 1 per cent. Several of the smaller states had no recruits unable to read and write.

Public libraries, museums, botanical gardens, art-collections, picture-galleries, schools of music and design, and academies of arts and sciences are to be met with in most of the capitals, and in many of the country towns, upwards of 200 of which possess one or more permanently established theatres. In no country is the book and publishing trade more universally patronised than in Germany, where the chief centres are Leipzig and Stuttgart. The press annually sends forth from 8000 to 10,000 works, while about 3000 papers and journals are circulated throughout the empire. Of the current newspapers a comparatively small number only exert any marked influence, but many of the German scientific and literary periodicals enjoy a world-wide reputation (see BOOK-TRADE, Vol. II. page 315). The censorship of the press was abolished by a decree of the diet of 1848, and freedom of the press, under certain restrictions which were promulgated in 1854, has been introduced.

Religion.—In regard to religion, it may be stated generally that Protestantism predominates in the north and middle, and Roman Catholicism in the south, east, and west, although very few states exhibit exclusively either form of faith. The Protestants belong chiefly either to the Lutheran confession, which prevails in Saxony, Thuringia, Hanover, and Bavaria east of the Rhine, or to the Reformed or Calvinistic Church, which prevails in Hesse, Anhalt, and the Palatinate. A union between these two churches has taken place in Prussia. There are six Roman Catholic archbishopries and eighteen Roman Catholic bishopries in Germany.

The following is the proportion of the different denominations, according to the census of 1885:

	Protestant.	Roman Catholic.	Other Christians.	Jews.	Other Religions.
Prussia	18,244,405	9,621,763	82,030	366,575	3,697
Bavaria	1,521,114	3,339,440	5,731	53,697	217
Saxony	3,075,961	87,762	10,263	7,755	262
Würtemberg	1,378,216	598,239	5,322	13,171	137
Baden	566,327	1,004,388	3,322	27,104	114
Hesse	643,881	278,450	8,605	26,114	161
Mecklenburg Duchies	665,941	4,282	381	2,844	75
Oldenburg	264,294	74,363	1,180	1,650	28
Thuringian States	1,187,533	20,073	1,451	3,852	154
Free-towns	701,877	22,554	3,252	18,332	5,891
Other States	807,347	23,995	965	5,202	100
Alsace-Lorraine	312,941	1,210,325	3,771	36,876	442
Total	29,369,847	16,785,734	125,673	563,172	11,278
Percentage	62·63	35·82	0·27	1·2	·03

Judicial System.—In terms of the Judicature Acts of 1877 and 1878, a uniform system of law-courts was adopted by the different states in 1879. The appointment of the judges and the arrangement of the courts are left in the hands of the individual federal states, except in the case of the *Reichsgericht*. The *Amtsgericht*, with one judge, is competent for civil cases not involving more than £15 value, and for various minor offences. More important criminal cases are tried by the *Schöffengericht*, in which two *Schöffen* (assessors), chosen by rotation from among the qualified private citizens, sit with the judge. It deals with crimes whose punishment is not more than three months' imprisonment or a fine of £30, and with theft, fraud, &c., in which the damage is not more than 25s. Above these [illegible] divided into civil and criminal [illegible]), and consisting of a president, directors (who preside over the chambers), and ordinary members. In connection with the Landgericht, jury-courts (*Schwurgerichte*) are periodically held to try the more serious cases. These consist of three judges and twelve jurymen. A concurrent jurisdiction with the Landgericht in commercial matters is possessed by the chambers for commercial cases (*Handelssachen*), in which a judge sits as president along with two arbiters (*Handelsrichter*) appointed for three years from among the qualified citizens. A revising jurisdiction over the courts below is possessed by the *Oberlandesgericht*, which is divided into civil and criminal *senates*, each of

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1888
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राजपूताना
KOTAH, RAJPUTANA.

which must contain four councillors and a president. The supreme court of appeal for the whole empire is the *Reichsgericht* at Leipzig, to which appeals lie even from the jury-trials. It possesses an original jurisdiction in the case of treason against the empire. It also is divided into civil and criminal senates, with a general president, senate-presidents, and councillors, appointed by the emperor on the recommendation of the Bundesrath. Seven members are required to be present in order to give a valid decision in any of the senates; and in the *plenum* one-third of the members must be present.

The penal and commercial codes are now uniform throughout Germany; but the Code Civil is still administered in Alsace-Lorraine and Rhenish Prussia, the Prussian land laws in the greater part of Prussia, and German common law in Saxony, parts of Prussia, Bavaria, &c.

Army.—By the constitution of April 16, 1871, the Prussian military system was extended to the whole empire; though certain alterations in the Landwehr service were introduced by the Military Organisation Bill of 1888. Every German who is *wehrfähig*—i.e. capable of bearing arms—must be in the standing army for seven years (generally his twenty-first to his twenty-eighth year). Three years must be spent in active service (*bei den Fahnen*), and the remainder in the army of reserve. He then spends five years in the first class of the *Landwehr* (q.v.), after which he belongs to the second class till his thirty-ninth year. Besides this, every German, from seventeen to twenty-one, and from thirty-nine to forty-five, is a member of the *Landsturm*, a force only to be called out in the last necessity. Those who pass certain examinations require to serve only one year with the colours. They are known as *einjährige Freiwillige*. Article 63 of the constitution enacts that the whole land forces of the empire shall form a united army under the command of the emperor in war and peace. The sovereigns of the principal states have the right to select the lower grades of officers, but even their selections require to obtain the approval of the emperor, whose authority is paramount—article 64 expressly declaring that all German troops are bound to obey unconditionally the orders of the emperor. The imperial army is divided into 18 army corps, and in 1889, on its peace footing, consisted of 19,457 officers, 472,498 rank and file, 88,283 horses, and about 1500 guns. The grand total of 491,955 men comprises 166 regiments of infantry, 327,930 men; 21 battalions of jäger, or riflemen, 12,219 men; 93 regiments of cavalry 67,370 men; 52 regiments of artillery, 61,600 men; 21 battalions of engineers, 12,906 men; 18 battalions of military train, 6372 men; and 3558 other officers and men. On its war footing, the total is about 2,267,000 men, besides the Landsturm. The estimated cost of the army for 1889–90 was £19,531,755 (ordinary), and £3,214,100 (extraordinary).

Navy.—The formation of a German navy, due to the initiative of Prussia, dates from 1848, and of late years rapid progress has been made. In 1889 the imperial fleet consisted of 77 vessels, with a total tonnage of 186,196 tons. Of these, 12 were sea-going ironclads, 14 armour-clad boats, 18 frigates and corvettes, 3 gunboats, 7 avisos or despatch-boats, 4 unarmoured cruisers, 10 training-ships and boats, and 9 others. This fleet was manned by 15,246 seamen and boys, and officered by 10 admirals and 688 other officers, besides 90 surgeons. The seafaring population of Germany are liable to service in the navy instead of in the army. They are estimated at 80,000, of whom 48,000 are serving in the merchant navy at home, and about 6000 in foreign navies. After three years' active service, four years are spent in the naval reserve and five more in the first class of the *Seewehr*, which corresponds to the Landwehr of the land forces. Seamen who have not served in the navy belong from seventeen to thirty-one years of age to the second class of the Seewehr. The empire has two ports of war: Kiel (q.v.), and Wilhelmshaven (q.v.) in the Bay of Jahde on the North Sea; and there is a naval dockyard at Danzig. The estimated cost of the navy for 1889–90 was £2,211,715 (ordinary), and £343,580 (extraordinary).

Revenue.—The revenue of the German empire is derived (1) from the customs dues on tobacco, salt, and beet-root sugar, which are entirely made over to it by all the states; from those on brandy and malt, which are also assigned by most of the states; from taxes on playing-cards and stamps, from posts, telegraphs, and railways, the imperial bank, and various miscellaneous sources; (2) from extraordinary sources—as votes for public buildings and loans; and (3) from the proportional contributions (*Matrikular-beiträge*) of the various states. The chief items of expenditure are the maintenance of the Reichstag and various government offices, the army and navy, posts and telegraphs, railways, justice, pensions, and other miscellaneous claims. The average income for the five years 1881–82 to 1885–86 was £30,121,470, and the average expenditure £30,564,200. The budget estimates for the four years 1886–87 to 1889–90 are: income, £33,594,915, £47,463,165, £61,296,305, and £48,402,695; expenditure, £34,676,600, £43,846,735, £60,188,440, and £47,267,870. The national debt on March 31, 1888, was £42,561,485; in 1874 it was £235,080. Of the former total £36,000,900 represented the funded debt, bearing interest chiefly at 4 per cent. By November 1888 this sum had risen to £40,746,700, and it was estimated that an additional loan of £16,471,787 would be required to meet the additional military expenditure authorised by the law of March 27, 1889.

Social Organisation.—All the states of the empire recognise four distinct orders—viz. the nobility, clergy, burghers, and peasantry, and all distinguish three distinct grades of nobility. The highest of these includes the members of reigning houses, and the descendants of families who belonged at the time of the old empire to the sovereign nobility of the state, and were *reichsunmittelbar*, or directly connected with the empire, as holding their domains directly under the emperor, but whose houses have subsequently been *mediatised*, or deprived of sovereign power in accordance with special treaties between the state and the princes. There are at present fifty princely and fifty-one *gräfliche* (countly) mediatised families, who, in accordance with the act of the diet of 1806, have equality of rank with reigning houses, and enjoy many of the special privileges which were accorded to the high nobles of the empire. The second grade of nobility is composed of counts and barons not belonging to reigning or mediatised houses, whilst the third and lowest grade includes the knights and hereditary patrimonial proprietors of Germany.

Before we proceed to consider the political organisation of the new German empire, we shall briefly describe—(1) the principal features of the constitution of the old Germanic empire, which was overthrown by the first Napoleon in 1806; and (2) that Bund or federal government which lasted from 1815 to 1866, when Austria was excluded from the Confederation, and the hegemony of Germany was transferred to Prussia.

The Old Germanic Empire.—The states of this empire comprised three chambers or colleges: (1)

The Electoral College, which consisted of the archiepiscopal electors of Mainz, Treves, and Cologne, and the secular electors, of whom there were originally only four, but whose number was subsequently increased to five, and who at the dissolution of the empire were represented by the sovereigns of Bohemia, Bavaria, Saxony, Brandenburg, and Brunswick-Lüneburg or Hanover (see ELECTORS). (2) The College of the Princes of the Empire, who had each a vote in the diet, and were divided into spiritual and temporal princes. (3) The Free Imperial Cities, which formed a college at the diet, divided into two benches, the Rhenish with fourteen cities, and the Swabian with thirty-seven; each of these had a vote. These colleges, each of which voted separately, formed the diet of the empire. When their respective decisions agreed, the matter under discussion was submitted to the emperor, who could refuse his ratification of the decisions of the diet, although he had no power to modify them. Ordinary meetings were usually summoned twice a year by the emperor, who specified the place at which the sittings were to be held; during the later periods of the empire they were held at Regensburg (Ratisbon). The diet had the right to enact, abrogate, or modify laws, conclude peace and declare war, and impose taxes for the general expenses of the state. The Aulic Chamber, and the Cameral or chief tribunal of the empire, decided in cases of dispute between members of the diet. The emperors were chosen by the electors in person or by their deputies; and after their election and coronation, which usually both took place at Frankfort-on-the-Main, the emperor swore to the 'capitulation' or constitution of the empire. After the dissolution of the empire in 1806, its place was nominally taken by the Confederation of the Rhine, which owed its existence to Napoleon, and which lasted till 1815.

Germanic Confederation.—The Germanic Confederation was established by an act of the Congress of Vienna in 1815, on the overthrow of Napoleon. It was an indissoluble union, from which no single state could at its own pleasure retire. Its central point and its executive and legislative powers were represented by the federative diet, which held its meetings at Frankfort-on-the-Main, and was composed of delegates from all the confederate states, chosen, not by the people, but by the various governments. The diet deliberated either in a limited council (the Federative government) or as a general assembly (*Plenum*). In the limited council there were seventeen votes, of which eleven of the principal states had each one, while the remaining states divided the six collective votes between them. The Plenum, which met only when any organic change was to be effected in the diet itself, embraced seventy votes, of which Austria and the five German kingdoms had each four, while the other states had three, two, or one vote each in proportion to their individual importance. It rested with the limited council, which executed the enactments of the Plenum, and despatched the ordinary business of the Confederation, to decide (by a majority of voices) whether a question should be submitted to the Plenum, where it was not debated, but simply decided by a majority of ayes or noes. Austria presided in both assemblies, and had a casting vote in cases of equality. The diet, as a collective body, had the right of concluding peace and alliances, and declaring war; but this power could only be exercised for the maintenance of the independence and external security of Germany and the individual integrity of the several federative states, which on their part were bound to submit to the diet the consideration of all questions in dispute between themselves and other powers. Where such differences could not be settled by the committee empowered by the Plenum to consider them, they were finally referred to a special tribunal known as the 'Austrägal' Court, which was composed of several members of the Confederation invested for the time with full powers. From 1866 to 1871 the place of this Bund was held by the North German Confederation, which is described in the historical part of this article.

Present German Empire.—The seventy-ninth article of the constitution of the North German Confederation provided for the admission of the South German states into the new Bund; and the war between France and Germany, which broke out in July 1870, and in which all the German princes and peoples took part, gave an irresistible impetus to the desire for national unity. On the 15th November 1870 the grand-duchies of Baden and Hesse joined the Bund; Bavaria followed on the 23d, and Würtemberg on the 25th of the same month. Shortly after, the king of Bavaria wrote a letter to the king of Prussia, urging him to re-establish the German empire. This brought the question under the notice of the Bund; and on the 10th December 1870 it was agreed, by 188 votes to 6, that the empire should be restored, and that the king of Prussia should be acknowledged hereditary German emperor. The latter solemnly accepted the new dignity at Versailles, 18th January 1871.

The constitution for the new empire was promulgated by an imperial decree of April 16, 1871, and is contained in seventy-eight articles, under fourteen sections. Alsace and Lorraine were brought under its provisions from January 1, 1874. The preamble expressly declares that all the states of Germany form an eternal union for the protection of the territory of the Bund, and for the care of the welfare of the German people. The empire possesses the exclusive right of legislation on all military and naval affairs; on civil and criminal law for general application; on imperial finance and commerce; on posts, telegraphs, and railways in so far as the interests of the national defence and general trade are concerned. Wherever the laws of the empire come into collision with those of particular states of the Bund, the latter must be held as abrogated; and in all disputes that arise among the individual states, the imperial jurisdiction is supreme and final.

There are two legislative bodies in the empire—the *Bundesrath*, or Federal Council, the members of which are annually appointed by the governments of the various states; and the *Reichstag*, the members of which are elected by universal suffrage and ballot for a period of three years. The former deliberates on proposals to be submitted to the latter, and on the resolutions received from it. A simple majority is sufficient to carry a vote in the Bundesrath. Acting under the direction of the chancellor of the empire, the Bundesrath, in addition to its legislative functions, represents also a supreme administrative and consultative board, and, as such, has eleven standing committees—viz. for the army and fortresses; naval matters; tariff, excise, and taxes; trade and commerce; railways, posts, and telegraphs; civil and criminal law; financial accounts; foreign affairs; Alsace-Lorraine; matters affecting the constitution; and the arrangement of business. Each committee consists of representatives of at least four states of the empire, besides the president; but the foreign affairs committee includes the representatives of the kingdoms of Bavaria, Saxony, and Würtemberg, and of two other states annually selected by the Bundesrath.

The Reichstag contains approximately one member for every 120,000 inhabitants; in 1889 there

were 397 members. The Reichstag must be convened annually, but cannot be assembled unless the Bundesrath is also in session. Its proceedings are public; the members are unpaid, but enjoy various privileges and immunities. A dissolution of the Reichstag before the end of three years requires the consent of the Bundesrath; and the new election must take place within sixty days, and the meeting of the new Reichstag within ninety days after the dissolution. By a law passed in 1888, to come into force in 1890, the legislative period has been increased to five years. The Reichstag elects its own president. The members of the Bundesrath may claim a right to speak in the Reichstag; but no one can be a member of both assemblies at once. All imperial laws must receive the votes of an absolute majority of both bodies, and, to be valid, must, in addition, have the assent of the emperor, and be countersigned when promulgated by the *Reichskanzler*, or chancellor of the empire, who is appointed by the emperor, and is *ex officio* president of the Bundesrath.

The votes in the two assemblies are apportioned as follows: Prussia has 17 votes in the Bundesrath and 236 in the Reichstag; Bavaria has respectively 6 and 48; Würtemberg, 4 and 17; Saxony, 4 and 23; Baden, 3 and 14; Mecklenburg-Schwerin, 2 and 6; Hesse, 3 and 9; Oldenburg, Saxe-Weimar, and Hamburg, each 1 and 3; Brunswick, 2 and 3; Saxe-Meiningen, Saxe-Coburg-Gotha, and Anhalt, 1 and 2; and the remainder 1 vote in each assembly. Alsace-Lorraine has 15 votes in the Reichstag, but in the Bundesrath is represented only by 4 commissioners (*Kommissäre*) without votes, appointed by the Statthalter. To assist the Reichskanzler in managing imperial affairs, a number of offices (not ministries) have developed in the course of time for the different departments of state.

According to the eleventh article of the constitution, the German emperor, with the consent of the Bundesrath, can declare war, make peace, enter into treaties with foreign nations, and appoint and receive ambassadors. If, however, the territory of the empire is attacked, he does not require the consent of the Bundesrath to declare war, but can act independently. Changes in the constitution can be effected only by imperial law, and they are held to be rejected if 14 votes are given against them in the Bundesrath.

Political Parties.—There is no imperial responsible ministry in Germany, and the government is independent of changes in the relative strength of the various parties in the Reichstag. For years Prince Bismarck formed alliances now with this, now with that party, according to the aim he had in view; and his opponents, even when they defeated his measures, had no thought of superseding him in the chancellorship. The chief political parties in the Reichstag may be roughly grouped under the names Liberal, Conservative, and Clerical. Of the first, the *National Liberals*, a party dating from the crisis of 1866, whose object is a united Germany on constitutional lines, were long the most influential supporters of Bismarck. In 1879, however, they differed from him on the questions of the new protectionist and military policies; and in consequence they suffered a severe defeat at the next election. The advanced wing of the Liberal party, known as the *Fortschrittspartei*, formed a coalition in 1884 with a considerable number of 'Secessionists' from the National Liberals, and founded the present *Deutsch-Freisinnige-partei*, under the leadership of Eugen Richter, with a radical programme including demands for a responsible ministry, annual budgets, freedom of speech, meeting, and press, and payment of members. The reorganised National Liberal party once more approached Bismarck, and, having in 1888 joined the Conservatives in support of the government measures, now forms part of the so-called *Cartellpartei*, or Coalition party. The Conservatives include the *Deutsche Konservativen*, a distinctly reactionary group, and the *Deutsche Reichspartei* or *Frei-Konservativen*, best perhaps described as Liberal-Conservatives, aiming at a fair imperial government as the first necessity of their country. The *Centre* or Ultramontane party, organised by Windthorst since 1871, is essentially the Roman Catholic clerical party, and has offered the most determined and best-organised resistance to Bismarck. A temporary alliance, however, with this party enabled the chancellor to carry his protectionist proposals in 1889. The *Elsässer*, the French party of Alsace, generally vote with the Centre. Among the smaller parties the most significant is that of the *Social Democrats*, who, in spite of all the hostile socialist legislation, rose from 2 votes in 1871 to 24 in 1884. The smaller parties, with special and more private views, are known as *Particularisten*; they include the *Poles*, aiming at the separation of Polish Prussia from Germany, *Welfen*, or Hanoverian royalists, and some individual members. In 1884 the Conservatives had 76 votes; in 1887, 129; the National Liberals, 45 and 99; the Freisinnige, 104 and 32; the Centre, 109 and 98; the Social Democrats, 24 and 11.

See *Statistik des Deutschen Reichs*, published periodically by the Imperial Statistical Office, and the *Statistisches Jahrbuch* (annually since 1880). The Jahrbuch for 1889 contains an index to the Statistik since 1871. Kutzen, *Das Deutsche Land* (3d ed. 1880); Berghaus, *Deutschland und seine Bewohner* (2 vols. 1860); Daniel, *D. nach seinen physischen und politischen Verhältnissen* (2 vols. 5th ed. 1878); Delitsch, *Forschungen zur D. Landes- u. Volkskunde* (1885); Neumann, *Das Deutsche Reich in Geog., Statist., und Topograph. Beziehung* (1872-74), and *Geog. Lexikon des D. Reichs* (1883); S. Baring-Gould, *Germany, Past and Present* (2 vols. 1881); Baedeker's Travellers' Handbooks; and the *Handbuch für das Deutsche Reich*, Kürschner's *Staatshandbuch*, the *Statesman's Year-book*, and the *Almanach de Gotha* for the current year. On the Constitution, Störk's *Handbuch der Deutschen Verfassung* (1884).

History.—The earliest information we have of the Germans, the peoples and tribes who dwelt among the dense forests that stretched from the Rhine to the Vistula and from the Danube to the Baltic Sea, comes to us from the Romans, the principal authority being Tacitus. The term Germans is of Celtic origin, though its meaning is not precisely known. It was in all probability borrowed by the Romans from the Gauls. The Germans were not one homogeneous nation, but a multitude of separate and independent tribes, who had racial origin, language, and similarity in their mode of life for their only links of connection. The first tribes of Germanic race to come into collision with the arms of Rome were the Cimbri and Teutones, who in 113 B.C. had invaded Styria, and there met with defeat from the troops of the consul Papirius. The next Roman general who made trial of their prowess was Cæsar. When in 58 B.C. he began his campaigns in Gaul, he found several hordes of Germans, mostly Marcomanni and Suevi, settled between the Rhine and the Vosges, and even on the western side of these hills. Appealed to by the Gauls of those regions to free them from their German oppressors, Cæsar, in spite of the redoubtable stature and strength of his enemies, and of their personal valour, inflicted a crushing defeat upon their ambitious chieftain, Ariovistus, and chased him and his followers across the Rhine. Then, continuing his campaign, he drove back (55 B.C.) behind the same river those tribes that had settled on its western side in

Belgium, and even followed them into their original seats in Germany in two short campaigns. The tranquillity which was established through his exertions was, however, so seriously disturbed again by 15 B.C. that Augustus felt it necessary to make a serious effort to subjugate these troublesome neighbours of Gaul. Accordingly Drusus was sent (12 B.C.) at the head of eight legions across the frontier; and in four campaigns he was so far successful that he subdued the Batavians, Frisians, and other tribes as far as the Elbe, and likewise the Chatti on the Main. After the death of Drusus in 9 B.C. Tiberius conquered the Tencteri and Usipetes, who lived on the middle Rhine, and afterwards the Sicambri and others settled on the lands at its mouth. In 6 A.D. the work was taken up by Varus; but Varus, in attempting to consolidate the Roman power by depriving the Germans of their national institutions and imposing upon them those of the empire, provoked a general revolt of the subject peoples. The animating spirit of this patriotic movement was Arminius (q.v.), chief of the Cherusci, who not only overthrew Varus, and slew him and his legions (9 A.D.) at one blow in the Teutoburg Forest, but with irresistible *élan* swept the Romans before him until he had expelled them from German soil. The struggle was renewed by Germanicus, who defeated Arminius and avenged the Roman honour, but at length, in 16 A.D., withdrew his legions. Henceforth the Romans contented themselves with guarding their long frontier next Germany; and in this task they succeeded for some time as much by stirring up dissension amongst the chiefs of their foemen as by their own military skill. Yet they managed to bring the Frisians and Batavians under their influence, until in 69 a fierce revolt broke out amongst the latter people, a revolt which was only quelled after a terrible struggle. About one hundred years later the Germans began to reverse the order of things. In the period 166-174 Aurelius was engaged in beating back a formidable incursion of the Marcomanni and Quadi into Roman territory. From the 3d century we no longer read of single tribes, but of great confederations of tribes, as the Goths, Alemanni, Franks, Frisians, Saxons, Thuringians, and others. These powerful combinations began to harass the Romans all along their frontier line, from the mouth of the Rhine to the middle Danube, attacking the towns and forts, and breaking down the walls they had built to keep this boundary. In 375 began the movement before which Rome eventually succumbed. The Huns invaded Europe, and by their coming gave rise to what is known as the 'Volkerwanderungen' or 'Migrations of the Peoples.' The races who lay next to Roman territory were being pressed upon more and more by those behind, upon whom the full brunt of the Hunnic attack had fallen, and at last they began to pour across the boundary in such broad deep streams that the dams of the Romans were broken completely down before their onrush. Of the history of Germany itself we learn little more that is authentic until we come down to the times of the Franks, except that the Slavic nations following in the wake of the Huns seized and occupied the lands left vacant by the German emigrants who had gone Romewards, and that of the confederations still remaining at home in their original lands the most important were the Alemanni, the Thuringians, Saxons, Bavarians, and Franks. The historian turns his attention more especially towards the last-named, since by them the kingdoms of France and Germany were subsequently formed. See FRANCE, and FRANKS.

After the gradual expulsion or retirement of the Romans from Germany, the country necessarily became subdivided into numerous petty states, each governed by its own chief. The erection of the Franko-Merovingian empire in France had given preponderance to the Frankish power on both sides of the Rhine, and when Charlemagne succeeded in 771 to the German as well as the Gallic possessions of his father, Pepin the Short, he found himself possessed of an amount of territory and a degree of influence which speedily enabled him to assert supremacy over the whole of the west of Germany, while his conquests over the heathen Saxons in the north, and the Avars who then held Pannonia in the south-east, extended his German dominions from the North Sea to the Alps, and from the Rhine as far as Hungary. With Charlemagne, who received the imperial crown at the hands of the pope in 800, began the long line of emperors and kings who occupied the German throne for more than a thousand years; and with him, too, ended the stability of the vast fabric which he had reared on the ruins of Roman power, for at his death in 814 no member of his family was competent to wield the imperial sceptre. Although in 843 some portions of his German possessions fell, in accordance with the treaty of Verdun, to his grandson Ludwig, surnamed 'the German,' who was recognised as king of Germany or East Francia, the final and absolute partition did not take place till 887, when Arnulf seized the eastern throne. On the extinction, in 911, of the degenerate Carlovingian dynasty in the person of Ludwig 'the Child,' the provincial rulers, who, together with the archbishops, bishops, and abbots, constituted the chief members of the diet or national assembly, arrogated to themselves (in imitation of the practice of the nobles of the ancient German tribes) the right of electing their sovereign, who, however, could not assume the imperial title till he had been crowned by the pope. At this period there were in Germany five nations—the Franks, Saxons, Bavarians, Swabians, and Lorrainers. The Franks, as the descendants of those who had conquered the land and founded the empire, enjoyed a pre-eminence over the others; and hence, on the extinction of the Carlovingian race, the choice of the prince-electors seems to have fallen almost as a matter of course on the chief of the Franks, the Duke of Franconia, who reigned as king of Germany from 911 to 918, under the title of Conrad I. At his own instigation, his rival and adversary, Henry, Duke of Saxony, was chosen as his successor, and proved himself an able and warlike prince. The conquests of this great prince over the Danes, Slavs, and especially over the terrible Magyars, were confirmed and extended by his son and successor, Otho I. (936-973), who carried the boundaries of the empire beyond the Elbe and Saale, and who, by his acquisition of Lombardy, laid the foundation of the relations which existed for many ages between the rulers of Germany and the Italian nation. Otho's coronation-festival was eventful, as it formed the precedent for the exercise of those offices which, till the dissolution of the empire, were regarded as connected with the dignity of the secular electors; for on that occasion, while the emperor dined with his three spiritual electors, he was waited upon by the secular princes—the Elector of Bavaria (afterwards of Saxony) serving as grand-marshal; of Swabia (afterwards of Bohemia), as grand-cupbearer; and of Lorraine (afterwards of Brandenburg), as arch-chamberlain.

Otho II. (973-983), Otho III. (983-1002), and Henry II. (1002-24) belonged to the House of Saxony, which was succeeded by that of Franconia, in the person of Conrad II. (1024-39), an able ruler, who added Burgundy to the empire. His son and successor, Henry III. (1039-56), tempo-

rarily extended German supremacy over Bohemia, Denmark, and Hungary, while he repressed the insolence and despotism of the great nobles of Germany. And while his stern piety moved him to interfere with force in the strife over the papal chair, he also gained the respect of his contemporaries by his zeal for justice and his valour in the field. The minority of his son and successor, Henry IV. (1056–1106), enabled the nobles to recover much of their former power, and to apply a check to the further consolidation of the imperial authority, which had been considerably extended under the two preceding reigns. Henry's constant quarrels with the astute Gregory VII. entangled him in difficulties and mortifications, which culminated in his humiliation at Canossa, and only ended with his life, and which plunged Germany into anarchy and disorder. The emperor's most formidable rival, Rudolph of Swabia, was defeated and slain in 1080. With his son and successor, Henry V. (1106–25), who made peace with the papacy by the Concordat of Worms in 1122, the male line of the Franconian dynasty became extinct; and after the crown had been worn (1125–37) by Lothair of Saxony, who made a bold attempt to recover some of the prerogatives of which at his election the empire had been deprived through papal intrigues, the choice of the electors, after a season of dissension and intrigue, fell upon Conrad III. (1138–52), Duke of Franconia, the first of the Hohenstaufen dynasty. His reign, in which the civil wars of the Guelphs (q.v.) and Ghibellines began, was distracted by the dissensions of the great feudatories of the empire, while the strength of Germany was wasted in the disastrous Crusades, in which Conrad took an active part. On his death the electoral college for the first time met at Frankfort, which retained the honour of being the place at which the sovereign was elected and crowned till the dissolution of the empire in the 19th century. Frederick I. (1152–90), surnamed Barbarossa, Duke of Swabia, was, at the recommendation of his uncle Conrad, chosen as his successor, and the splendour of his reign fully warranted the selection. By the force of his character Frederick acquired an influence over the diets which had not been possessed by any of his immediate predecessors, and during his reign many important changes were effected in the mutual relations of the great duchies and counties of Germany, while we now for the first time hear of the *hereditary* right possessed by certain princes to exercise the privilege of election. Unfortunately for Germany, this great monarch suffered the interests of his Italian dominions to draw him away from those of his own country, whilst his participation in the Crusades, in which both he and the flower of his chivalry perished, was only memorable for the misfortunes which it entailed on the empire. The interval between the death of Frederick Barbarossa (1190) and the accession of Rudolf I. (1273), the first of the Hapsburg line, which, through a female branch, still reigns in Austria, was one of constant struggle, internal dissension, and foreign wars. Individually, the princes of the Hohenstaufen dynasty were popular monarchs, their many noble and chivalrous qualities having endeared them to the people, while one of the race, Frederick II. (1212–50), was, after Charlemagne, perhaps the most remarkable sovereign of the middle ages; but their ambitious designs on Italy, and their constant but futile attempts to destroy the papal power, were a source of misery to Germany, and with Frederick II. ended the glory of the empire, till it was partially revived by the Austrian House of Hapsburg. His son, Conrad IV. (1250–54), with whom the Hohenstaufen line ended in Germany, was succeeded, after a brief and troubled reign, by various princes, who in turn, or in some cases contemporaneously, bore the imperial title without exercising its legitimate functions or authority. This season of anarchy (known as the Great Interregnum) was terminated at the accession of Rudolf I. (1273–91), who, by the destruction of the strongholds of the nobles, and the stringent enforcement of the laws, restored order. His chief efforts were, however, directed to the aggrandisement of his Austrian possessions, which embraced Styria, Carinthia, Carniola, and Tyrol.

For the next 200 years the history of the German empire presents very few features of interest, and may be briefly passed over. Adolf of Nassau, who was elected to succeed Rudolf, was compelled in 1298 to yield the crown to the son of the latter, Albert I. (1298–1308), whose reign is chiefly memorable as the period in which three Swiss cantons, Unterwalden, Schwyz, and Uri, established their independence. After the murder of Albert the throne was occupied in rapid succession by Henry VII. (1308–13), who added Bohemia to the empire, and, conjointly, by Frederick III. of Austria and Ludwig IV. of Bavaria (1313–47). Charles IV. (1347–78) of Luxemburg was the successful candidate among many rivals; and, although he attended specially to the interests of his hereditary possessions of Bohemia, Moravia, Silesia, and Lusatia, he did not entirely neglect those of the empire, for which he provided by a written compact, known as the *Golden Bull* (1356), which regulated the rights, privileges, and duties of the electors, the mode of the election and coronation of the emperors, the coinage, customs, and commercial treaties of the empire, and the rights and obligations of the free cities. His son, Wenceslaus (1378–1400), who was finally deposed, brought the royal authority into contempt, from which it was scarcely redeemed by Rupert of the Palatinate (1400–10). The nominal reign of Sigmund (1410–37), the brother of Wenceslaus, would demand no notice were it not for his connection with the Council of Constance in 1414, at which Huss was condemned, and which was followed by the disastrous Hussite wars. The readiness with which Sigmund lent himself to the interests of Henry V. of England, and of all other princes who ministered to his love of personal display, brought discredit on the imperial dignity, while his dishonourable desertion of Huss will ever attach ignominy to his name. Albert II. of Austria (1438–39), after a reign of less than two years, in which he gave evidence of great capacity for governing, was succeeded by his cousin, Frederick IV. (1440–93), an accomplished but avaricious and indolent prince, whose chief object seemed to be the aggrandisement of the House of Hapsburg, with which the title of emperor had now become permanently connected (see AUSTRIA), while he neglected the interests of Germany collectively, and suffered the Turks to make unchecked advances upon its territory. Maximilian I. (1493–1519), the son and successor of Frederick, resembled him in few respects, for he was active, ambitious, and scheming, but deficient in steadiness of purpose. His marriage with Mary, the rich heiress of her father, Charles the Bold of Burgundy, involved him in the general politics of Europe, while his opposition to the reformed faith preached by Luther exasperated the religious differences which disturbed the close of his reign. Maximilian had, however, the merit of introducing many improvements in regard to the internal organisation of the state, by enforcing the better administration of the law, establishing a police and an organised army, and introducing a postal system. With him originated, moreover, the special courts of jurisdiction known as the

'*Imperial Chamber*' and the '*Aulic Council*;' and in his reign the empire was divided into ten circles, each under its hereditary president and its hereditary prince-convoker. Maximilian lived to see the beginning of the Reformation, and the success that attended Luther's preaching; but the firm establishment in Germany of the reformed faith, and the religious dissensions by which its success was attended, belong principally to the reign of his grandson, Charles I., king of Spain, the son of the Archduke Philip and of Joanna, the heiress of Spain, who succeeded to the empire under the title of Charles V. (1519–56). The management of his vast possessions in Spain, Italy, and the Netherlands, and the wars with France, in which he was so long implicated, diverted him from his German territories, which he committed to the care of his brother Ferdinand. The princes of Germany were thus left to settle their religious differences among themselves, and to quell, unaided by the head of the state, the formidable insurrection of the peasants (1524–25), which threatened to undermine the very foundations of society, and which had followed close upon the nobles' war (1522–23), raised by Ulrich von Hutten and Francis von Sickingen in the vain hope of securing a more united Germany under the emperor. The rising of the lower orders was due to the preaching of the fanatic Münzer, and other leaders of the sect of *Anabaptists* (*q.v.*), which had arisen from a perverted interpretation of some of the tenets advanced by Luther. Charles's determined opposition to the reformers rendered all settlement of these religious differences impracticable; and although, by the aid of his ally, Maurice of Saxony, he broke the confederation of the Protestant princes known as the League of Schmalkald, he was forced by his former ally to sign the peace of Augsburg in 1555, which granted tolerance to the Lutherans; and, in his disgust at the complicated relations in which he was placed to both parties, he abdicated in favour of his brother Ferdinand (1556–64), who put an end to much of the religious dissension that had hitherto distracted the emp[illegible] toleration to the Protestants [illegible] was personally mild and [illegible] troubled by domestic and foreign aggressions—the different sects disturbing the peace of the empire at home, while the French and the Turks assailed it from abroad.

During the next fifty years the empire was a prey to internal disquiet. Maximilian II. (1564–76) was indeed a wise and just prince, but the little he was able to effect in reconciling the adherents of the different churches, and in raising the character of the imperial rule, was fatally counteracted by the bigotry and vacillation of his son and successor, Rudolf II. (1576–1612), in whose reign Germany was torn by the dissensions of the opposite religious factions, while each in turn called in the aid of foreigners to contribute towards the universal anarchy which culminated in the Thirty Years' War, begun under Rudolf's brother and successor Matthias (1612–19); continued under Ferdinand II. (1619–37), an able, but cruel and bigoted man; and ended under Ferdinand III. (1637–57), by the treaty of Westphalia, in 1648. The effect of the Thirty Years' War (*q.v.*) was to depopulate the rural districts of Germany, destroy its commerce, burden the people with taxes, cripple the already debilitated power of the emperors, and cut up the empire into a multitude of petty states, the rulers of which exercised almost absolute power within their own territories. Leopold I. (1658–1705), a haughty, pedantic man, did not avail himself of the opportunities afforded by peace for restoring order to the state, but suffered himself to be drawn into the coalition against France, whilst his hereditary states were overrun by the Turks, and were indebted for their safety to Sobieski, king of Poland. Although success often attended his arms, the cunning of Louis XIV. prevented peace from bringing the emperor any signal advantages; and it was in this reign that Strasburg was attached to the French empire. The reigns of Joseph I. (1705–11) and Charles VI. (1711–40), with whom expired the male line of the Hapsburg dynasty, were signalised by the great victories won by the imperialist general, Prince Eugene, in conjunction with Marlborough, over the French, in the war of the Spanish succession (1702–13). But the treaty of Utrecht (1713) brought no solid advantage to the empire. The disturbed condition of Spain and Saxony opened new channels for German interference abroad. Germany was further distracted, after the death of Charles, by the dissensions occasioned by the contested succession of his daughter, Maria-Theresa, who claimed the empire in virtue of the Pragmatic Sanction drawn up by her father in 1713, and through her of her husband, Francis I. of Lorraine, after their rival, the Bavarian Elector, Charles VII., had by means of Prussian aid been elected in 1742 to the imperial throne. Charles, however, was obliged to cede his crown after a brief occupation of three years. Constant disturbances, intensified during the Seven Years' War (1756–63), when Frederick the Great of Prussia maintained his character of a skilful general at the expense of the Austrians, made the reign of Francis I. (1745–65) one of trouble and disaster. Joseph II., his son (1765–90), during the lifetime of Maria-Theresa, who retained her authority over all the Austrian states, enjoyed little beyond the title of emperor, to which he had succeeded on his father's death. But when he ultimately acquired his mother's vast patrimony he at once entered upon a course of reforms, which were, however, premature, and unsuited to the cases to which they were applied; whilst his attempts to re-establish the supremacy of the imperial power in the south of Germany were frustrated by Prussian influence.

Leopold II., after a short reign of two years, was succeeded in 1792 by his son Francis II., who, after a series of defeats by the armies of the French Republic, and the adhesion, in 1805, of many of the German princes to the alliance of France, which led to the subsequent formation of the Rhenish *Confederation under the protectorate of Napoleon*, resigned the German crown, and assumed the title of Emperor of Austria. (See for further details AUSTRIA, NAPOLEON, FRANCE, PRUSSIA, and the articles on the other German states.) From this period till the Congress of Vienna of 1814–15 Germany was almost entirely at the mercy of Napoleon, who deposed the established sovereigns, and dismembered their states in favour of his partisans and dependants, while he crippled the trade of the country, and exhausted its resources by the extortion of subsidies or contributions. The second peace of Paris (1814) restored to Germany all that had belonged to her in 1792; and, as a reconstruction of the old empire was no longer possible, those states which still maintained their sovereignty combined, in 1815, to form a German Confederation. Of the 300 states into which the empire had once been divided there now remained only 39, a number which was afterwards reduced to 35 by the extinction of several petty dynasties. The diet was now reorganised, and appointed to hold its meetings at Frankfort-on-the-Main, after having been formally recognised by all the allied states as the legislative and executive organ of the Confederation; but it failed to satisfy the expectations of

the nation, and soon became a mere political tool in the hands of the princes, who simply made its decrees subservient to their own efforts for the suppression of every progressive movement. The festival of the Wartburg, and the assassination of Kotzebue, were seized as additional excuses for reaction; and though the French revolution of 1830 so influenced some few of the German states as to compel their rulers to grant written constitutions to their subjects, the effect was transient, and it was not till 1848 that the German nation gave expression, by open insurrectionary movements, to the discontent and the sense of oppression which had long possessed the minds of the people. The princes endeavoured by hasty concessions to arrest the progress of republican principles, and, fully recognising the inefficiency of the diet, they gave their sanction to the convocation, by a provisional self-constituted assembly, of a national congress of representatives of the people. Archduke John of Austria was elected Vicar of the newly-organised national government; but he soon disappointed the hopes of the assembly by his evident attempts to frustrate all energetic action on the side of the parliament, while the speedy success of the anti-republican party in Austria and Prussia damped the hopes of the progressionists. The refusal of the king of Prussia to accept the imperial crown which the parliament offered him in 1849 was followed by the election of a provisional regency of the empire; but as nearly half the members had declined taking part in these proceedings, or in a previous measure, by which Austria had been excluded, by a single vote, from the German Confederation, the assembly soon lapsed into a state of anarchy and impotence, which terminated in its dissolution. The sanguinary manner in which insurrectionary movements had in the meanwhile been suppressed by Prussian troops both in Prussia and Saxony put an effectual end to republican demonstrations; and in 1850 Austria and Prussia, after exhibiting mutual jealousy and ill-will which more than once seemed likely to end in war, combined to restore the diet, whose first acts were the intervention in Sleswick-Holstein in favour of Denmark, and the abolition of the free constitutions of several of the lesser states. From that period the diet became the arena in which Austria and Prussia strove to secure the supremacy and championship of Germany; every measure of public interest was made subservient to the views of one or other of these rival powers; and the Sleswick-Holstein difficulties were the principal questions under discussion in the federal parliament, down to the rupture between Prussia and Austria, and the dissolution of the Bund in 1866.

The immediate occasion of the war of 1866 was the difference that arose between Prussia and Austria, after the convention of Gastein (1865), as to the occupation and disposal of the territory taken from Denmark in the short war of 1864 (see SLESWICK). But the real grounds lay in that rivalry between the two states for the leadership of Germany, the germ of which is as old as the time of the Great Elector (see FREDERICK-WILLIAM), and which has shown itself at many epochs of their history. There can be little doubt that the feeling of the German people, as distinguished from the princes and bureaucracy, had, in recent times at least, been in favour of the purely German Prussia as their leader, rather than Austria. And when the parliament of Frankfort in 1849 offered the imperial crown to the king of Prussia, the unity of Germany might have been secured without bloodshed, had the monarch been less scrupulous, or had he had a Bismarck for his adviser. But that opportunity being let slip, and the incubus of the 'Bund' being restored, it became apparent that the knot must be cut by the sword.

By the treaty of Gastein Austria and Prussia agreed to a joint occupation of the Elbe duchies; but to prevent collision it was judged prudent that Austria should occupy Holstein, and Prussia Sleswick. Already a difference of policy had begun to show itself: Prussia was believed to have the intention of annexing the duchies; while Austria began to favour the claims of Prince Frederick of Augustenburg. In the meantime, both nations were making ready for the struggle; and Italy, looking upon the quarrel as a precious opportunity to strike a blow for the liberation of Venetia, had secretly entered into an alliance with Prussia.

In the sitting of the German diet, June 1, 1866, Austria, disregarding the convention of Gastein, placed the whole matter at the disposal of the Bund, and then proceeded to convoke the states of Holstein 'to assist in the settlement of the future destination of the duchy.' Prussia protested against this as an insult and a violation of treaty; demanded the re-establishment of the joint occupation; and, while inviting Austria to send troops into Sleswick, marched troops of her own into Holstein. Instead of responding to this invitation, Austria withdrew her forces altogether from Holstein, under protest; and then, calling attention to this 'act of violence' on the part of Prussia, proposed that the diet should decree 'federal execution' against the enemy of the empire. This eventful resolution was carried by a great majority on the 14th June 1866; Hanover, Saxony, Hesse-Cassel, and Hesse-Darmstadt voting for it. The resolution having passed, the Prussian plenipotentiary, in the name of his government, declared the German Confederation dissolved for ever, and immediately withdrew.

Thereupon identical notes were sent by Prussia to the courts of Saxony, Hanover, and Hesse-Cassel. The terms were not accepted, and the Prussian troops at once took military possession of the three kingdoms without resistance. War was now declared against Austria; the Prussian host, numbering in all 225,400 men, with 774 guns, invaded Bohemia at three several points. The Austrians, who had been surprised in a state of ill-organised unreadiness, had assembled an army of 262,400 men and 716 guns; and the greater portion of these were stationed, under General Benedek, behind the Riesengebirge, expecting the attack from Silesia. The Prussian armies meanwhile crossed the Erzgebirge without opposition, drove the Austrian army steadily and quickly back with heavy losses, and, after effecting a junction, moved steadily forward to meet the Austrian army, now concentrated between Sadowa and Königgrätz. Here, on July 3, was fought the decisive battle. The Austrian cavalry made heroic efforts to turn the tide of victory; but the stern trained valour of the Prussians, armed with the till then little known breech-loading 'needle-gun,' was invincible, and the Austrian army was broken and dissolved in precipitate flight. The Prussians lost upwards of 9000 killed and wounded; the Austrian loss was 16,235 killed and wounded, and 22,684 prisoners. After this decisive defeat, which is known as the battle of Königgrätz or Sadowa, all hope of staying the advance of the Prussians with the army of Benedek was at an end; a truce was asked for, but refused; and not till the victorious Prussians had pushed forward towards Vienna, whither Benedek had drawn his beaten forces, was a truce obtained through the agency of the emperor of the French, the peace of Prague (August 20). Italy (q.v.), though more than half-inclined to stand out for the cession by Austria of

the Trentino, as well as Venetia, reluctantly agreed to the armistice (August 12).

A brief campaign sufficed for the defeat of the minor states of Germany that had joined Austria —viz. Bavaria, Würtemberg, Baden, and Hesse-Darmstadt; and, after peace had at last been arranged, some of them were forced to submit to a certain loss of territory. Saxony only escaped incorporation with Prussia through the resolute opposition of Austria supported by France; but the little kingdom, like all the other states that had taken arms against Prussia, was forced to pay a heavy war indemnity. Even the little principality of Reuss had to pay 100,000 thalers into the fund for Prussian invalids. The states north of the Main which had taken up arms against Prussia were completely incorporated—viz. Hanover, Hesse-Cassel, Nassau, Frankfort, and a small portion of Hesse-Darmstadt, as well as Sleswick-Holstein and Lauenburg; and the other states north of the Main were united with Prussia in a confederacy of a more intimate nature than before existed, called the *North German Confederation*.

Austria, by the treaty of Prague (20th August 1866), was completely excluded from participation in the new organisation of the German states, and formally agreed to the surrender of Venetia to Italy, to the incorporation of Sleswick-Holstein with Prussia, and to the new arrangements made by Prussia in Germany. A portion of the fifth article of this treaty secured that, if the 'inhabitants of the northern districts of Sleswick declare, by a free vote, their desire to be united to Denmark, they shall be restored accordingly;' but this was withdrawn in 1878 by secret treaty between Austria and Germany. Though losing no territory to Prussia, Austria had to pay 40 millions of thalers for the expense of the war.

The North German Confederation, as thus constituted, possessed a common parliament, elected by universal suffrage, in which each state was represented according to its population. The first or constituent parliament met early in 1867, and adopted, with a few modifications, the constitution proposed by Count Bismarck. The new elections then took place, and the first regular North German parliament met in September 1867. According to this constitution, there was to be a common army and fleet, under the sole command of Prussia; a common diplomatic representation abroad, of necessity little else than Prussian; and to Prussia also was entrusted the management of the posts and telegraphs in the Confederation.

The southern German states which up to this point had not joined the Bund, were Bavaria, Baden, Würtemberg, Hesse-Darmstadt, and Liechtenstein, with a joint area of 43,990 sq. m., and a total population (1866) of 8,524,460. But, though these states were not formally members of the Bund, they were so practically, for they were bound to Prussia by treaties of alliance offensive and defensive, so that in the event of a war the king of Prussia would have at his disposal an armed force of upwards of 1,100,000 men.

During the next few years the North German Confederation was employed in consolidating and strengthening itself, and in trying to induce the southern states to join the league. The Zollverein (q.v.) was remodelled and extended, until by the year 1868 every part of Germany was a member of it, with the exception of the cities of Hamburg and Bremen, and a small part of Baden. This paved the way for the formal entrance of the southern states into the confederation; but they still hung back, though the ideal of a united Germany was gradually growing in force and favour.

In the spring of 1867 a war between Prussia and France seemed imminent, from difficulties arising out of the occupation of Luxemburg by the former; but by the good offices of the British government a congress of the great powers (Italy included) was assembled at London, at which an arrangement satisfactory to both nations was amicably agreed upon, Luxemburg remaining in the possession of the king of Holland. It was evident, however, that hostilities had only been postponed, and on both sides extensive military preparations were carried on.

In 1870 the long-threatened war between Prussia and France broke out. On July 4 of that year the provisional government of Spain elected Prince Leopold of Hohenzollern, a relative of King William of Prussia, to fill their vacant throne. This step gave the greatest umbrage to the French government; and though by the advice of William I. of Prussia Prince Leopold resigned his candidature, it was not satisfied, but demanded an assurance that Prussia would at no future period sanction his claims. This assurance the king refused to give; and on the 19th of July the emperor of the French proclaimed war against Prussia. Contrary to the expectation of France, the southern German states at once decided to support Prussia and the northern states, and placed their armies, which were eventually commanded by the Crown-prince of Prussia, at the disposal of King William.

By the end of July the forces of both countries were congregated on the frontier. Napoleon, however, lost a fortnight in delays after the declaration of war, and it was discovered that the French army was by no means in a state of satisfactory preparation, while the Germans were splendidly organised, and much superior in number. The result was that the French, instead of marching to Berlin as they anticipated, never crossed the Rhine, and had to fight at a disadvantage in Alsace and Lorraine.

On August 2 the French obtained some trifling success at Saarbrück, but the rapidly following battles of Weissenburg (August 4), Wörth, and Spicheren (both August 6) were important German victories. The German advance was hardly checked for a moment, though the losses on both sides were very heavy. The battle of Gravelotte, in which King William commanded in person, was fought on the 18th; and, though the Germans suffered immense loss, they were again victorious, and forced Bazaine to shut himself up in Metz. The Emperor Napoleon and Marshal MacMahon in vain attempted to proceed to the relief of Bazaine. They were surrounded at Sedan, and completely defeated with heavy loss. The emperor surrendered on the 2d September, with his whole army, about 90,000 men, and was sent as a prisoner into Germany. By the 19th of September the Prussians had reached Paris, and commenced a vigorous siege. Strasburg capitulated on the 27th after a severe bombardment; and on 28th October Bazaine surrendered Metz with an army of 6000 officers and 173,000 men, 400 pieces of artillery, 100 mitrailleuses, and 53 eagles. Verdun capitulated on the 8th November; Thionville followed on the 24th; after which there were several capitulations of lesser importance.

The French made extraordinary efforts to raise armies and relieve Paris, but, with the exception of a momentary gleam of success on the Loire, they met with nothing but severe defeats. Of these may be mentioned the battle of December 3 in the Forest of Orleans, and that of Le Mans, January 12, in which contests Prince Frederick-Charles took altogether 30,000 prisoners. After numerous unsuccessful sorties, and enduring great sufferings from famine, Paris surrendered on the 29th of January, and the war was virtually at an end. The French army of the east, 80,000 strong, under Bourbaki, was compelled to retire to Switzerland on the 31st.

By the peace of Frankfort (May 10, 1871) France was condemned to pay a war indemnity of 5 milliards of francs, or £200,000,000; and the province of Alsace, along with the German part of Lorraine, was ceded to Germany.

A very important result of the war was to complete the fusion of the northern and southern states of Germany. The southern states joined at once in the war against France; in November of 1870, Baden and Hesse leading the way, they all became members of the German Confederation; and next month the re-establishment of the German empire was almost unanimously resolved, with the king of Prussia as hereditary emperor. It was at Versailles, on 18th January 1871, that the king was proclaimed emperor of Germany.

The new German empire set vigorously to work to organise itself as a united federation, under the skilful leadership of Prince Bismarck, who was appointed Reichskanzler or Imperial Chancellor. Almost at once it found itself involved in the ecclesiastical contest with the Church of Rome, known as the 'Kulturkampf,' which had previously begun in Prussia. The origin of the struggle was an effort to vindicate the right of the state to interfere, somewhat intimately, with the behaviour, appointments, and even educational affairs of all religious societies in the country. The Jesuits were expelled in 1872, and Pope Pius IX. retorted by declining to receive the German ambassador. The famous Falk or May Laws were passed in Prussia in 1873–4–5, and some of their provisions were extended to the empire. Several German prelates, refusing obedience, were expelled from Germany; and the [illegible] ecclesiastical affairs became so se [illegible] passed a law in 1874 making marriage a civil rite. The pope issued an encyclical declaring the Falk laws invalid, and matters seemed for a time to be at a deadlock. On the election of a new pope, Leo XIII., in 1878, attempts were made to arrange a compromise between the empire and the papal see. Falk, the Prussian 'Kultus'-minister, resigned in 1879, and certain modifications were made in the obnoxious laws in 1881 and 1883. Bismarck took a further step towards Canossa in 1885 when he proposed the pope as arbiter between Germany and Spain in the dispute as to the possession of the Caroline Islands; and he practically owned himself beaten in the concessions which he granted in revisions of the politico-ecclesiastical legislation in 1886 and 1887. Another semi-religious difficulty which demanded government interference was the social persecution of the Jews (*Judenhetze*), which reached a climax in 1880–81.

In more strictly political affairs the rapid spread of socialism excited the alarm of the government. Two attempts on the life of the emperor (in May and June 1878) were attributed more or less directly to the Social Democrat organisation, and gave the signal for legislative measures conferring very extensive powers upon the administration to be used in suppressing the influence of socialism. These socialist laws, though limited in duration, have invariably been renewed (sometimes with added stringency) before their validity expired; in 1889 several of the most important towns of the empire were in what is called 'the minor state of siege' for police purposes, and a new permanent socialist law was carried by government in November of that year. A plot, happily futile, to blow up the emperor and other German rulers at the inauguration of the National Monument in the Niederwald in 1883 was considered by government to justify its repressive measures. Prince Bismarck, however, was not content with repressive measures; he has endeavoured by improving the condition of the working-classes to cut the ground from beneath the feet of the socialistic propagandists. The acknowledgment in the emperor's message to the Reichstag in 1881, that the working-classes have a right to be considered by the state, was followed by laws compelling employers to insure their workmen in case of sickness and of accident, and by the introduction (1888) of compulsory insurance for workmen against death and old age—measures that have been by some called 'state-socialism.'

The energetic commercial policy of government also, which since 1879 has been strongly protectionist, has its springs in similar considerations; and the recent colonial policy, which began in 1884 with the acquisition of Angra Pequeña, may be considered to be stimulated partly by the desire to gratify the national self-respect, and partly to provide new outlets under the German flag for the surplus population, and new markets for the home manufactures. None of the German colonies as yet, however, either in Africa or the Pacific Ocean, have proved of any great commercial value. The assembling of the Congo Congress at Berlin in 1885 fitly marked Germany's admission to the list of colonial powers. On the maintenance and improvement of the army and navy the German government has bestowed the most unremitting care, urged especially by the attitude of the 'Revanche' party in France, though hitherto the imperial policy has been entirely pacific.

Considerable parliamentary friction has been caused more than once by the unwillingness of the Reichstag to vote military supplies to the amount and in the manner demanded by the emperor and chancellor. The latter desire to have practically a free hand in military matters, while the national parliament seeks to exercise a constitutional control over the army resembling that illustrated in Great Britain by the annual Mutiny Act. A compromise was effected in 1874 in virtue of which the military strength was fixed and the supplies granted for periods of seven years at a time. In 1886 the government proposed to terminate the current *Septennat* in 1887 instead of in 1888, and to immediately add largely to the peace strength of the army. On the rejection of the bill the Reichstag was dissolved (January 1887) by the emperor and an appeal made to the country. The Iron Chancellor still possessed the confidence and the gratitude of the people, and the new elections in February 1887 resulted in a crushing defeat for the opponents of the government, notably the Freisinnige and the Social Democrats. One of the most remarkable features of this election was a letter written by the pope in favour of the army bill, for which he subsequently received a *quid pro quo* in a further modification of the May laws. The Military Septennate Bill was immediately passed, and was followed in 1888 by a Military Organisation Bill, which made several changes in the conditions of service in the landwehr. The subsequent budgets show an enormous increase in the extraordinary military expenditure. While thus seeking peace by preparing for war, Germany has not failed to use diplomacy for the same end.

A personal meeting of the emperors of Germany, Austria, and Russia in 1872 was considered a proof of a political alliance (*Dreikaiserbund*); and, when Russia drifted somewhat apart from Germany in 1878, an offensive and defensive alliance was formed between Austria and Germany in 1879. Italy afterwards entered this Triple Alliance. Germany's influence on the Eastern Question was recognised in 1878, when the plenipotentiaries of the powers met at the Congress of Berlin.

On 9th March 1888 the Emperor William I. died. His son Frederick, at that time suffering from a cancerous affection of the throat, immediately issued a proclamation, in which he promised to consider

'new and unquestionable national needs,' and it was understood and to some extent felt that a more liberal era had commenced. The new emperor, however, died on 15th June, and William II., his son, who succeeded, at once recurred to the policy of William I. and Prince Bismarck. Much painful excitement was caused by a medical dispute as to the nature and cause of the late emperor's fatal illness, which speedily developed into a party question, discussed on both sides with virulent acrimony. The latter part of 1888 and the year 1889 were devoted by the young emperor to visiting the courts of several of his fellow-sovereigns in Europe. Germany continued to extend her colonial empire, not, however, without coming to blows with the natives; and in Samoa became temporarily involved in hostilities with one of the chiefs. Difficulties on the east coast of Africa led in 1888 to a blockade by the British and German fleets to prevent the importation of arms and to check the slave-trade. This lasted until October 1889.

See *Monumenta Germaniæ Historica*, edited by Pertz, Waitz, &c., a national work begun in 1819 and still unfinished; 'Deutsche Geschichte,' by Dahn, Dove, &c., in Giesebrecht's *Geschichte der Europäischen Staaten* (Gotha, 1883 *et seq.*); W. Menzel, *Geschichte der Deutschen* (5th ed. 5 vols. Stutt. 1855; Eng. trans. Lond. 1848–49); D. Müller, *Geschichte des Deutschen Volks* (11th ed. Berlin, 1884); Stacke, *Deutsche Geschichte* (Leip. 1880–81); Treitschke, *Deutsche Geschichte im 19ten Jahrhundert* (5 vols. Leip. 1879 *et seq.*); Ranke, *Deut. Geschichte im Zeitalter der Reformation* (6th ed. 6 vols. 1889–82; Eng. trans. 1845–47); Müller's *Politische Geschichte der Gegenwart* (an annual historical register; with a résumé translated into English by Peters, 1876). Also works by Luden, K. B. Menzel, Leo, Waitz, Souchay, Sugenheim, &c.; see also under FREDERICK THE GREAT, THIRTY YEARS' WAR, BISMARCK, and other special articles.

Works in English: J. Bryce, *Holy Roman Empire* (7th ed. 1884); J. Sime, *History of Germany* (1874, in Freeman's 'Historical' series); C. T. Lewis, *History of Germany* (1874); S. Baring-Gould, *Germany, Present and Past* (2 vols. 1879); Baring-Gould and Gilman, *Germany* (1886, 'Story of the Nations' series); S. Whitman, *Imperial Germany* (1889); *Official* (*German*) *Account of Franco-German War*, translated by Major Clarke (1872–81); Seeley's *Life of Stein* (1879); and see under special articles.

LANGUAGE AND LITERATURE.—The numerous dialects which were spoken by the different confederacies and tribes of ancient Germany were all derivatives from one branch of the Aryan or Indo-Germanic family of languages, which separated from the parent stock at a very early period, although subsequently to the separation of the Celtic. We can trace the co-existence of the two branches of Teutonic speech known as Low German and High German as far back as the 7th century, but there is no evidence to show that they existed as common uniform languages, from which their variously modified dialects were respectively derived. According to Max Müller, there never was *one* common Teutonic language, which diverged into two streams; while the utmost we can venture to assert in regard to the various High and Low German dialects is that they respectively passed at different times through the same stages of grammatical development. The High German branch—which was spoken in the dialects of Swabia, Bavaria, and Franconia—may be classified under three periods—the Old High German, dating from the 7th century and extending to the period of the Crusades, or the 12th century; the Middle High German, beginning in the 12th century and continuing till the Reformation; and the New High German, dating from Luther's time to our own days. This New High German does not represent the victory of any one High German dialect over the others; it is rather the result of a compromise, which arose in the public tribunals of the empire. Luther found this compromise-speech best suited to his purpose in translating the Bible, and his selection of it effectually confirmed it in its literary supremacy. The chief modern High German dialects are the Bavarian, spoken with variations in Bavaria, Salzburg, Tyrol, Upper and Lower Austria, and Styria; Swabian, spoken in Würtemberg and the adjacent parts of Bavaria; and the Alemannic, spoken in Alsace, the south of Baden, and German Switzerland. The Saxon, [illegible] Silesian, Franconian, and other Hig[illegible] are grouped together as Midd[illegible] Each of these has a living literature of its own. Low German embraced two main branches, Lower Franconian and Old Saxon. The former, in which we have a fragment of a 9th-century translation of the *Psalter*, developed a tolerably rich literature in the 13th century, which subsequently gave birth to the Dutch and Flemish tongues. The oldest literary monument of Old Saxon also belongs to the 9th century; it is a Christian epic known as *Der Heliand* (q.v.)—i.e. The Healer or Saviour. Old Saxon developed into Middle Low German after the 13th century, with a copious enough literature, of which *Reineke Vos* (*circa* 1490), a translation from the Dutch branch, is the most important relic; and there are traces of popular Low German literature down to the 17th century. The chief extant dialects are the Frisian (q.v.) and Platt-Deutsch (q.v.). In addition to the various dialects which are commonly included under the heads of High and Low German, an important evidence of the cultivation of a form of German differing equally from the High and Low groups has been preserved to us in the Gothic translation of the Bible, which was made in the 4th century by Bishop Ulfilas. See GOTHS, PHILOLOGY.

The diffusion of Christianity among the Germanic tribes had the effect both of suppressing the use of the Runic characters that had been common to them and of changing the character of their literature, for, instead of the heroic sagas and 'beast-epics' (*Thier-epos*) of a sanguinary paganism, scriptural paraphrases, legends, and hymns were now selected; while the ancient system of alliteration by degrees gave place to the rhyming arrangement of the Latin versification common in the early periods of the middle ages. Charlemagne himself made a collection of German popular poetry; and under his successors in the 9th and 10th centuries some of the heroic epics dating from heathen times were written down (e.g. the *Hildebrandslied*), while the matter of others received a Latin dress at the hands of monkish poets. Under the Saxon emperors Latin became the language of the court, the church, and the law, while German was left entirely to the people, down to the first flourishing period of German poetry under the emperors of the Hohenstaufen line. The Italian wars of this dynasty, the stirring events of the Crusades, and the intercourse with the chivalry of France and Italy kindled a love for literature and romance in the princes and nobles of Germany. The vernacular dialects were once more used for literary purposes, especially the Swabian or court-speech. Many, both nobles and men of lower degree, belonged to the order of the *Minnesönger* (or Singers of Love), who roamed from castle to castle and from court to court, exhausting their ingenuity in devising new presentments of their usual subject, the romantic passion of love, and in inventing new and elaborate forms of versification. The epic subjects chiefly selected during the 13th and 14th centuries, by both courtly and popular singers, were based on the history of Troy, the deeds of Alexander the Great, the legendary lore of Charlemagne and his

paladins, and King Arthur and his knights, and of the Sangrael; and it is to this period that we must refer the *Nibelungen Lied* and *Gudrun*, which rank as the greatest treasures of German national literature. It was to these tales of Parzival, Lohengrin, and the Nibelungen that Richard Wagner turned in his efforts to create a national school of music-drama in the 19th century. Among the most successful romantic and epic poets and minnesingers belonging to the Swabian period we may specially indicate Heinrich von Veldeke, Gottfried of Strasburg, Ulrich von Lichtenstein, Hartmann von der Aue, Neidhart of Bavaria, Wolfram von Eschenbach, Walther von der Vogelweide, and Heinrich von Ofterdingen. The *Krieg auf der Wartburg*, which has been classed among the didactic poems of this age, relates a mythical contest of poetic skill between the three last named. The taste for the *Thier-epos* received a new impetus among the people in the middle of the 12th century by the re-translation, from the French into German, of the ancient poem of *Reinhard Fuchs*, which, according to the distinguished philologist Jakob Grimm, originated with the Frankish tribes, who carried it with them when they crossed the Rhine and founded an empire in Gaul, and from whom it was diffused among the neighbouring tribes of northern France and Flanders. German now began to be used for public proclamations and in collections of laws, of which the *Sachsenspiegel* (1230) and the *Schwabenspiegel* (1270) are the most noteworthy.

The period which succeeded the decline of chivalry was marked by a thorough neglect, among the higher classes, of national literature, which thus fell into the hands of the people. Yet some few chronicles, among which may be mentioned those of Limburg, Alsace, and Thuringia, were composed in the century from 1330 to 1430. This was the age of the *Meistersänger*, or artisan-poets, who formed themselves into guilds like their trade guilds, and composed their verses in conformity with the strict guild rules. 'Meistergesang' was at its zenith at the era of the Reformation; its most famous representative was Hans Sachs, the shoemaker of Nuremberg, who also wrote epics, fables, and dialogue-pieces. The most honourable place among the pioneer cultivators of German prose-writing belongs to Meister Eckhart, Tauler, Suso, and their followers, the mystics. To this age belongs also the great mass of the *Volkslieder*, or national ballads, in which Germany is specially rich; the fables and satires of Brandt (*Narrenschiff*, or *Ship of Fools*) and Mürner, and the romances of the satirist Johann Fischart. Most of the *Volksbücher* too, such as *Die Melusine*, *Die Haimonskinder*, *Kaiser Octavianus*, *Wigalois*, *Tyll Eulenspiegel*, *Dr Faust*, and *Die Schildbürger*, were written in the 15th and 16th centuries to meet the demand of the people for imaginative literature. The mysteries and passion-plays, which were at their height in the 15th century, and still linger at Oberammergau, in Upper Bavaria, and one or two other places, may be said to have given origin to the German drama, which numbered among its earliest cultivators Sachs, Rebhuhn, and Ayrer. The close of the 15th century produced several satires on the clergy and numerous theological writings for and against the tottering power of the Romish Church.

The writings of Luther, particularly his translation of the Bible, which fixed a literary language for the Germans, and the works of Ulrich von Hutten, Zwingli, and of many of the other reformers, were, however, the most important events in the history of German literature from the close of the 15th to the middle of the 16th century. But Luther addressed himself to the minds of his countrymen not merely through his polemical writings, but also by those noble hymns which, since his day, have constituted one of the greatest literary treasures of the kind. Many beautiful *Kirchen-lieder*, or church songs, were composed during the next centuries; to the 17th belong those of Gerhardt, Franck, and Scheffler, who may be counted among the best hymn-writers of Germany. Nor should the Roman Catholic hymns of Angelus Silesius be passed over. The example of Luther as a writer of prose German was laudably followed by Sebastian Franck in his historical books, by the mystic Jacob Böhme, and Arndt, the most widely read religious writer of the 16th century.

The fervent effusions of the devout and eloquent reformers were followed by a period of literary degeneration and stagnation, which is in a great measure to be ascribed to the demoralising effects of the Thirty Years' War, when Germany was a prey to all the evils inseparable from civil strife, fostered by foreign interference. The indirect result of this period of anarchy was to quench the national spirit and vitiate the popular taste; for, while the petty courts aped the habits, language, and literature of Versailles, the lower orders forgot their own literature, with its rich treasures of legends, tales, and ballads, and acquired a taste for the coarse camp-songs imported by foreign mercenaries, and the immoral romances borrowed from impure French and Italian sources. Almost the only names that break this barren wilderness are Moscherosch, a satirist; Grimmelshausen, who has left vigorous pictures of the Thirty Years' War; and Abraham a Santa Clara, a satirical preacher, possessed of both wit and humour.

What is known as the first Silesian school of German poetry was formed under the influence of the correct but cold Opitz (1597–1639); and he was staunchly supported by the lyric poet Fleming and the epigrammatist Logau. The succeeding second Silesian school, headed by Hoffman von Hoffmanswaldau, sought inspiration in the inferior Italian poets, and produced affected and extravagant pastorals. But, on the whole, the study of the national literature was neglected, and, although a host of learned societies were formed whose professed object was to purify and elevate the public taste, the results were lamentably unsatisfactory. The poems of Hagedorn (1708–54) and Haller (1708–77) struck a truer and more natural note. But it was not till Gottsched (1705–66) succeeded, in his *Critical Art of Poetry*, in drawing attention to the turgid pedantry and artificial stiffness of the classicist school that a better taste was awakened. In opposition to the Leipzig school, of which Gottsched was the centre, there arose the Swiss or Zurich school, in which Bodmer and Breitinger were the leaders. An adverse criticism by Gottsched of Bodmer's translation of *Paradise Lost* precipitated a controversy, known as the *Bodmer Streit*. The Leipzig school attached all importance to the purely intellectual and mechanical correctness of poetry; while Bodmer and his disciples considered rather the imaginative and emotional elements. As more or less the outcome of this contest arose the Saxon school, the leading member of which was the hymn-writer and fabulist Gellert, who for some years posed as the literary dictator of Germany; the Halle school with Gleim at its head; and the German æsthetic school, under the guidance of A. Baumgarten.

In the end of the 17th century German philosophy first lifted up its head in the writings of Leibnitz, C. Wolf, and Thomasius. Rabener and other contributors to the *Bremer Beiträge*, a group of lyric and dramatic writers who flourished in the beginning of the 18th century, were perhaps the first to bring literature

again into immediate touch with popular life. But it is with the names of Klopstock, Lessing, Wieland, and Herder that the brilliant epoch of modern German literature begins. Their influence was alike great and varied; for, while Klopstock's poem of the *Messiah*, and his *Odes*, in which he had taken Milton as his model, re-echoed the tender piety of the old reformers, and were so thoroughly German in their spirit that they at once met with an enthusiastic response in the hearts of the people, Lessing's comedy of *Minna von Barnhelm* and his drama of *Nathan der Weise* may be said to have created anew the dramatic art in Germany. Wieland, on the other hand, was the complete antithesis of Klopstock, although, like Klopstock and Lessing, he was the founder of a new style. He gave a graceful flexibility to German diction which it had never before been made to assume, imparted to his numerous tales and romances an undisguised sensuous materialism, which, like his style, had been borrowed from the French philosophers of his day, and thus introduced into the language and literature of Germany the germs of many defects, as well as graces, to which they had hitherto remained strangers. Herder is the typical representative of those who resorted for their inspiration to the simplicity of the *Volkslieder* and the poetry of nature and of the Orient. His predominant tendencies are indicated in his favourite motto, 'Light, love, life.' And he also did admirable work as a philosopher and critic. In fact, his philosophical critiques of foreign and German literature contributed materially to the complete literary revolution which ushered in the modern period of German poetry. The influence exerted on German literature by these writers, who may be regarded as its regenerators, was soon appreciable in every branch of knowledge. The Swiss Salomon Gessner shows some literary kinship with Klopstock in his sweetly sentimental idylls. Blumauer and Kortum, seeking to perpetuate the irony of Wieland, made travesty of more serious effusions. And it was in the same vein, but seasoned with stronger satire, that Lichtenberg wrote. From the impulse communicated by Lessing came the critical æsthetic writings of Winckelmann, and the books of men like Zimmermann (author of *On Solitude*) and Moses Mendelssohn. The aims which Herder had set before him were adopted by a band of writers whose chief characteristics conferred upon the age they lived in the name of the *Sturm-und-Drang* period. But the poetic spirit raged in them too violently and refused to be subjected to the laws and restraints of artistic production. Klinger, one of whose dramas gave title to the school, and 'Maler' Müller were the champions of the movement. Hamann, in spite of his oracular and enigmatical utterances, had much in common with this school, though he did not belong to it.

Among the galaxy of great names which have imparted renown to the literary and scientific annals of Germany during the last hundred years we can only instance a few of the principal writers who have more especially enriched the several departments of learning with which they have been associated. Philosophy, which originated, as stated, with Leibnitz (1646-1716), who, however, wrote in Latin and French, assumed a degree of individuality and completeness through the intellectual acumen and subtle analysis of Kant, Fichte, Schelling, and Hegel which have no parallel in any other country. Other names worthy of mention in this department are Fries, Jacobi, Herbart, Schopenhauer, Zeller, Feuerbach, Baader, Ed. von Hartmann, Lotze, Haeckel, Fechner, Wundt, and Pfleiderer. In theology Reinhard, Paulus, Schleiermacher, De Wette, Marheineke, Neander, Julius Müller, Lücke, Baur, Strauss, Möhler, Döllinger, Ewald, Hase, Lipsius, Dorner, Ritschl, Wellhausen, Holtzmann, and a host of others have infused new life into biblical inquiry. Invaluable results have been attained by the philological and critical researches of F. A. Wolf, Hermann, Müller, J. and W. Grimm, Bopp, Lassen, Gesenius, Schlegel, W. Humboldt, Lepsius, Bunsen, Von der Hagen, Lachmann, Simrock, Moritz Haupt, Benfey, Pott, Schleicher, Steinthal, Diez, &c. In archæology, history, and jurisprudence all nations owe a debt of gratitude to Winckelmann, Heeren, Lobeck, Von Raumer, Schlosser, Von Hammer, Gervinus, Dahlmann, Waitz, Ranke, Bluntschli, Niebuhr, Mommsen, and Duncker.

In poetry and belles-lettres the name of Goethe is a host in itself. In his *Leiden des Jungen Werther* ('The Sorrows of Young Werther') he carried the sentimental tendencies of the *Sturm-und-Drang* school to their culminating point; but his own later and very numerous works became in time more and more free from its blemishes, and rose to an almost Olympic calm, a Hellenic strength, and grace, and proportion. In Goethe's middle period he was intimately associated with Schiller (1759-1805), whose early works, *The Robbers*, *Fiesco*, and *Don Carlos*, threw the whole German people into a frenzy of excitement. Schiller's later dramatic works, if less exciting than these, gave evidence of more matured taste, while some of his ballads and lyrics may be said to stand unrivalled. The tendency of the German poets for drawing together into schools was again exemplified in the case of the *Göttinger Dichterbund*, formed at Göttingen about 1770. Its leading spirit was Voss, better known for his translation of the Homeric poems than for his idyllic *Luise*. With him were associated more or less closely Bürger (author of *Lenore*), Hölty, the two Counts Stolberg, and Claudius. They took Klopstock for their high-priest, and sang of friendship, love of country, and all high and noble ideals. Among the works of prose fiction which appeared soon after this period are the novelettes of Zschokke, the romantic tales of Vulpius, the artistic romances of Heinse, and the humorous romances of Hippel and J. G. Müller. Iffland attained great reputation as a writer of sensational dramas, and Kotzebue as an inexhaustible composer of light effective comedies.

The Romantic school, which succeeded the *Sturm-und-Drang* period, found for a while its inspiration in the medieval romances and in Shakespeare, admirably translated by Schlegel and Tieck. Its chief representatives and defenders were A. W. Schlegel, Friedrich von Hardenberg, better known as Novalis (1772-1801), Tieck, Fr. Schlegel, Schelling, and Wilhelm von Humboldt. Kleist is the chief dramatist of the school. Among the writers who were smitten with the same tendencies are the poet Hölderlin, and De la Motte Fouqué, E. T. W. Hoffmann, and Chamisso, who loved to dwell on the mysterious agencies of nature, which they attempted to individualise and bring into association with material forms, as in the *Undine* of the first, the fantastic tales of the second, and the *Peter Schlemihl* of the third. Jean Paul Richter, the satirist and humorist, though sometimes included in the Romantic school, in reality occupies a position apart from and far above his compeers; and few novelists ever exerted so lasting an influence on the literature and mode of feeling of their compatriots as that which Richter exercised over the minds of the middle classes of Germany during the close of the last and the early part of the present century. Poetry has also found noble representatives in the so-called *Vaterlandsdichter* (Poets of the Fatherland), among whom we may

instance, Theodor Körner and Arndt, whose spirited patriotic songs are intimately associated with the war of 1813 against Napoleon, in which the former fell fighting gloriously. Rückert and Uhland belong to the same school; but the former is more especially known for his admirable adaptations and translations from oriental languages, and the latter for his exquisite romances and ballads.

The public taste in fiction still encouraged the production of sentimental tales, in a sickly style, of which Clauren may be mentioned as an example, chiefly on account of the ridicule directed against him by the novelist Hauff, the champion of a healthier taste. Spindler, Wilibald Alexis (W. Häring), whose *Walladmor* and other books are imitations of Walter Scott, and Caroline Pichler also belonged to a sounder and more artistic school. Raupach occupied the stage with his historical tragedies and his comedies, rivalled in south Germany by Baron von Auffenberg, and on the Rhine by Immermann, known also as the author of the romance *Münchhausen*. Adolf Müllner and Grillparzer are also important names in the later history of the German drama.

The decade 1830 to 1840 is usually spoken of in German literary histories as the period of 'Young Germany,' a period of gifted but somewhat immature striving for independence and free self-development. Count Platen in his odes, sonnets, comedies, &c. represents the transition to this era, of which Karl Gutzkow, Börne, and Laube may be taken as characteristic representatives. But the greatest name of this time is that of Heinrich Heine, who ranks with Goethe and Schiller for lyrical power, and at the same time is master of an almost matchless prose style. Menzel signalised himself by his attacks upon Goethe, Heine, and Gutzkow. Auerbach may be regarded as the creator of the *Dorfgeschichte* or village story, in which he has been followed by Maximilian Schmidt and Anzengruber. The sombre and sentimental Lenau (Niembsch von Strehlenau) is perhaps the chief name of the later Austrian school, which includes Count Auersperg (Anastasius Grün), Karl Beck, Moritz Hartmann of Bohemia, and A. Meissner. Emanuel Geibel, even yet one of the most popular lyric poets in Germany, was the head of the band of poets who assembled round King Maximilian of Bavaria, among whom also were Dingelstedt, Bodenstedt (whose exquisite poems in the oriental style were published under the *nom de guerre* of Mirza Schaffy), and Paul Heyse. Gottschall wrote epic poems as well as dramas. Hebbel and Grabbe were both dramatists of vigorous but ill-disciplined power. Prutz, Hoffmann von Fallersleben, Schulze, Herwegh, Hebel, Freiligrath, (peculiarly skilful as a translator of English, Scottish, and French poetry), Schefer, Schack, Hamerling, and Leander (Volkmann) may also be mentioned among recent writers; Freiligrath and Hamerling have done better than average work as poets. Among modern epic poets are Jordan (*Die Nibelungen*), Kinkel, Redwitz (*Amaranth*), Otto Roquette (*Waldmeister's Brautfahrt*), Scherenberg, Böttger, and Victor von Scheffel (*Trompeter von Säkkingen*). Many of these are also dramatists; others are Halm (Baron Münch-Bellinghausen), Moser (a 'second Kotzebue'), Freytag, Ernst von Wildenbruch, Fitger, and Anzengruber. Paul Lindau has made a success as a writer of neat comedies; and in even slighter work Benedix, Töpffer, Blum, &c. are well-known names. Fiction in Germany, as with ourselves, has been developed to an enormous extent in the present century, and no more than a few of the most prominent names can be here mentioned. Ida von Hahn-Hahn, Fanny Lewald, Johanna Schopenhauer, Von Hillern, and E. Marlitt are among the best known of the lady-novelists, who have recently been joined by 'Ossip Schubin' (A. Kirschner). Gustav Freytag, one of the oldest, is still the most eminent of living novelists. Spielhagen, Hackländer, Gottschall, Gerstäcker, Paul Heyse, Charles Sealsfield, Ebers, Dahn, Scheffel, Lindau, Gottfried Keller (a Swiss), Oskar Meding (Samarow), Franzos, and George Taylor (Hausrath) have all in turn enjoyed wide popularity, to which some of them are still adding. Low German has been elevated to the dignity of a literary tongue by Fritz Reuter, one of the greatest, if not the greatest, of German humorists, and by Klaus Groth.

But numerous as have been writers of poetic and dramatic literature during the present century in Germany, the tendency of the German mind has of late years been rather to science than fiction. The immense impetus given to the taste for scientific inquiry by A. v. Humboldt's Travels, and by his *Cosmos* and *Views of Nature*, has been followed by the appearance of a multitude of records of travel, among the more important of which we can only instance those of Martius in Brazil, Pöppig in South America, Tschudi in Peru, Lepsius and Brugsch in Egypt, Schomburgk in British Guiana, Gützlaff in China, Siebold in Japan, the brothers Schlagintweit in the Alps and in central Asia, Barth, Vogel, Rohlfs, and Schweinfurth in Africa, and Leichhardt in Australia.

In conclusion we can only group together the names of a few of the many eminent Germans who by their labours and researches in physical and natural science have at once enriched the knowledge of the world and enhanced the literary and scientific glory of their own country. Without again referring to writers who have been already mentioned, we may specially instance, in astronomy and mathematics, Bessel, Encke, Struve, Gauss, and Mädler; in the natural sciences and in medicine, Johannes Müller, Ehrenberg, Carus, Oken, Schleiden, Von Buch, Liebig, Kopp, Simon, Dove, Virchow, Moleschott, Bischoff, Rose, Vogt, Werner, Poggendorf, Erdmann, Gmelin, Gräfe, Vogel, Rokitansky, Wagner, Schönbein, Helmholtz, Haeckel, Mitscherlich, W. Weber, Kirchhoff, Neumann, Du Bois Reymond, Hahnemann, Hufeland, Von Baer, and Dieffenbach; in history, archæology, and biography, Leo, Duncker, Curtius, Giesebrecht, Sybel, Treitschke, Becker, Boeckh, Preller, Creuzer, Jacobs, Wachler, Kuno Fischer, Preuss, Böttiger, Varnhagen v. Ense, Pertz, Lappenberg, Pauli, &c.; in geography, ethnology, statistics, politics, &c., Berghaus, Ritter, Petermann, Stein, Hübner, Klöden, Kohl, Bunsen, Bastian, Ideler, Zachariä, Gentz, Gneist, Ruge, Roscher, Schäffle, Riehl, Lassen, Unger, Zimmermann, and Otto Peschel; in law and jurisprudence, Savigny, Thibaut, Eichhorn, Pütter, Waitz, Feuerbach, Grolmann, and Mittermaier; in the history of æsthetics and the fine arts, Fr. Vischer, Carriere, R. Zimmermann, Weisse, Schassler, Ed. Müller, Waagen, Kirchmann, and Lübke.

The genius of her musicians has placed Germany at the head of the musical world. Such names as Seb. Bach, Handel, Gluck, Mozart, Haydn, Beethoven, and P. E. Bach in the 18th century, and Schubert, Spohr, Weber, Mendelssohn, Schumann, Brahms, Liszt (though a Hungarian by birth), and Wagner in the 19th, are known to all who take an interest in the art of sweet sounds. In connection with this subject the writings of Helmholtz, Köstlin, Ehrlich, Schumann, Wagner, and Liszt should be noticed.

Detailed accounts of the lives and literary careers of the principal writers, such as Goethe, Heine, Herder, Reuter, Richter, Schiller, &c., will be found under their several names. See also such articles as

ÆSTHETICS, BIOGRAPHY, DRAMA, MUSIC, PHILOSOPHY, PLATT-DEUTSCH, ROMANTICISM; and for the German printed character, BLACK LETTER.

Language.—The standard authority on German Lexicography is the great *Deutsches Wörterbuch*, begun in 1852 by the brothers Grimm, and still in progress, under the care of Moriz Heyne, Rudolf Hildebrand, Matthias Lexer, Karl Weigand, and F. Wülcker. Admirable books are the Dictionaries by D. Sanders (1860-65) and Kluge (1882), and the smaller books by Sanders (3d ed. 1883) and Weigand (4th ed. 1882), the latter the best of all the smaller dictionaries. Other successors of the Grimms were Hoffmann von Fallersleben, Uhland, Schmeller, Graff, Massmann, W. Wackernagel, M. Haupt, R. v. Raumer, Fr. Pfeiffer, Holtzmann, Müllenhoff, Zarncke, Bartsch, Wernhold, Paul, and Sievers; as well as, in the wider sense, Bopp and Schleicher. A few special books that may merely be named are Lexer's *Mittelhochdeutsches Handwörterbuch* (1869-78); Dieffenbach and Wülcker's *Hoch- und Nieder-Deutsches Wörterbuch der Mittleren und Neueren Zeit* (1874-85); O. Schade's *Altdeutsches Wörterbuch* (2d ed. Halle, 1873-81); Grimm's *Deutsche Grammatik*, edited by W. Scherer (Berlin, 1869-78); H. Rückert's *Geschichte der Neuhochdeutschen Schriftsprache* (1875); R. v. Raumer, *Geschichte der Germanischen Philologie* (1870); Trömel, *Die Litteratur der Deutschen Mundarten* (bibliographical, Halle, 1884); and Strong and Meyer's *History of the German Language* (1886).

Literature.—See W. Scherer's *Geschichte der Deutschen Litteratur* (Berlin, 1883), of which the Clarendon Press at Oxford has published a translation (2 vols. 1886); Koberstein's *Grundriss der Ges. der Deut. Nationallitteratur* (6th ed. 5 vols. Leip. 1872-74); Vilmar's *Gesch. der Deut. Nationallitteratur* (22d ed. 2 vols. 1885); Stern's *Lexicon der Deutschen Litteratur* (1882); and works by Wackernagel, Kurz, Gervinus (German poetry), Goedeke (poetry), Roquette, Koenig (illustrated), and Gottschall; for literature of 18th century, Hettner, Hillebrand, and Biedermann; for literature of 19th century, Julian Schmidt. Taylor of Norwich, Coleridge, De Quincey, Carlyle, and Lewes did much to spread the taste for German literature in England. See also Metcalfe's *Hist. of Ger. Lit.* (1858, based on Vilmar); W. Menzel's *History of German Literature* (trans. 4 vols. 1840); Bayard Taylor's *Studies in Ger. Lit.* (1879); and Hallam's *Lit. Hist. of Europe in the Middle Ages.* Among more recent books are Gostwick and Harrison's *Outlines of German Literature* (2d ed. Lond. 1883); A. M. Selss's *Critical Outline of Lit. of Germany* (trans. Lond. 1884); and W. M. MacCallum's *Studies in High German and Low German Literature* (1889).

Germen, a disused botanical synonym for Ovary (q.v.).

Germersheim, a town of the Bavarian Palatinate, occupies a marshy site on the left bank of the Rhine, 8 miles SSW. of Spires. Founded in 1276, it fell into the hands of the French in 1644, 1674, and 1688; and in 1793 the Austrians here defeated the French. Pop. 6132.

Germinal, the 'budding' month (March-April) in the French revolutionary Calendar (q.v.).

Germination (Lat. *germinatio*, 'sprouting'), the beginning of growth in a seed, or of the developmental process by which it is converted into a new plant. See SEED; also, for cryptogamic plants, FERNS, FUNGI, &c.

Germ Theory. See GERM.

Gérôme, LÉON, French historical genre-painter, was born at Vesoul, 11th May 1824, and in 1841 entered the studio of Paul Delaroche at Paris, at the same time attending the School of the Fine Arts. He began to exhibit in 1847; in 1855, 1857, and 1861 he travelled in the East; and in 1863 he was appointed professor of Painting in the School of the Fine Arts. His first great picture, 'The Age of Augustus and the Birth of Christ,' was exhibited in 1855; and four years later his 'Roman Gladiators in the Amphitheatre' raised to the highest pitch his reputation as a colourist and painter of the human figure, a reputation which was still further enhanced by 'Phryne before her Judges' (1861). In the same year he exhibited, among other pictures, 'Socrates searching for Alcibiades at the House of Aspasia,' 'The Two Augurs,' and a portrait of Rachel. 'Louis XIV. and Molière,' 'The Prisoner,' 'Cleopatra and Cæsar,' 'The Death of Cæsar,' 'The Plague at Marseilles,' 'Death of St Jerome,' 'Lioness meeting a Jaguar,' 'Rex Tibicen' (1874), and 'L'Eminence Grise' (1874) are among the best known of his subsequent works. See Mrs C. H. Stranahan, *History of French Painting* (1889).

Gerona (anc. *Gerunda*), capital of the Spanish province of the same name, is situated 65 miles by rail NE. of Barcelona. It contains a beautiful Gothic cathedral of the 14th and 15th centuries. The inhabitants carry on the manufacture of paper, cork-cutting, spinning, and weaving. The fortifications are now of little value. Pop. 15,015. The town was formerly a place of great strength, and has undergone several notable sieges, particularly in 1653, 1684, 1694, 1706, and 1809, on each occasion by the French.—The *province* of Gerona measures 2271 sq. m. in extent, and had in 1883 a pop. of 301,536.

Gerry, ELBRIDGE, American statesman, was born in Marblehead, Massachusetts, 17th July 1744, graduated at Harvard in 1765, and was elected to the Massachusetts Assembly in 1773. He was a member of the Continental Congress of 1776, and served on several important committees; and in 1789 the Republican party elected him to the first National Congress. He was one of the envoys sent in 1797 to establish diplomatic relations with France. His colleagues, Marshall and Pinckney, being Federalists, were ordered to quit France, but Gerry was permitted to remain; and he did remain, to the indignation of Americans, until his recall was ordered. Elected governor of Massachusetts in 1810, Gerry, who was a keen partisan, removed the holders of civil offices and replaced them with Republicans; and he unfairly rearranged the districts of the state so as to secure the advantage to his own party—a manœuvre for which his opponents coined the word *gerrymander*. He was defeated in 1812, but his party rewarded his zeal by electing him to the vice-presidency of the United States, in which office he died, 23d November 1814, at Washington. There is a Life by James T. Austin (2 vols. Boston, 1828-29).

Gers, a department in the south-west of France, separated by Landes from the Bay of Biscay, with an area of 2415 sq. m., a climate healthy and temperate, a soil only moderately productive, no mineral riches, scarcely any trade, and an agricultural population, among whom education has not risen above a very low level. In 1861 there were 298,931 inhabitants, but the number has since steadily decreased; in 1881 it had fallen to 281,532; in 1886 to 274,391. There are parallel lines of hills in the south, separated by fan-shaped valleys which expand as they extend towards the plains in the north. The Gers and other principal rivers are tributaries of the Garonne and Adour. One-half of the surface is devoted to agriculture, and nearly a sixth to vineyards. Wine of very moderate quality is produced in considerable quantity; great part of it is converted into Armagnac brandy, which, after Cognac, is esteemed the best. The department has five arrondissements, those of Auch, Condom, Lectoure, Lombez, and Mirande; the capital is Auch.

Gersau, a village in the Swiss canton of Schwyz, on the Lake of Lucerne, and near the foot of the Rigi. Pop. (1880) 1771. From 1390 till it was absorbed by the French in the Helvetian Republic (1798) the village and its territory, 5 miles square, was an independent republic. In 1817 it became part of Schwyz. See Coolidge in the *Engl. Histor. Review*, July 1888.

Gerson, JOHN, one of the most eminent scholars and divines of his time, was born at the village of Gerson, in the diocese of Rheims, December 14, 1363, his proper name being Jean Charlier. He was educated in Paris, at the College of Navarre, under the celebrated Peter d'Ailly. Here he rose to the highest honours of the university, and ultimately to its chancellorship, having acquired by his extraordinary learning the title of Doctor Christianissimus. He was a clear and rational theologian, an enemy to scholastic subtleties, while his reason found rest from all its difficulties in a devout Christian mysticism. During the unhappy contests which arose out of the rival claims of the two lines of pontiffs in the time of the Western Schism, the university of Paris took a leading part in the negotiations for union; and Gerson was one of the most active supporters of the proposal of that university for putting an end to the schism by the resignation of both the contending parties. With this view he visited the other universities, in order to obtain their assent to the plan proposed by that of Paris. But, although he had the satisfaction of seeing this plan carried out in the Council of Pisa, it failed, as is well known, to secure the desired union. In a treatise inscribed to his friend D'Ailly he renewed the proposal that the rival pontiffs (now not two, but three since the election of John XXIII. at Pisa) should be required to resign; and in the new council held at Constance in 1414 he was again the most zealous advocate of the same expedient of resignation. But his own fortunes were marred by the animosity of the Duke of Burgundy and his adherents, to whom Gerson had become obnoxious, and from whom he had already suffered much persecution, on account of the boldness with which he had denounced the murder of the Duke of Orleans. To escape their vengeance he was forced to remain in exile; and he retired from Constance, in the disguise of a pilgrim, to Rattenberg in the Tyrol, where he composed his celebrated work, *De Consolatione Theologiæ*, in imitation of that of Boëthius, *De Consolatione Philosophiæ*. It was only after the lapse of several years that he was enabled to return to France, and take up his residence in a monastery at Lyons, of which his brother was the superior. He devoted himself in this retirement to works of piety, to study, and to the education of youth. The only fee he took from his pupils was a promise to repeat the prayer, 'Lord, have mercy on thy poor servant Gerson.' He died 12th July 1429, in his sixty-sixth year. His works fill five volumes in folio (Antwerp, 1706). The famous treatise on the *Imitation of Christ*, (q.v.) has been ascribed to him by some writers, but it is now hardly doubtful that the true author was Thomas à Kempis. The authority of Gerson is much relied on by the advocates of Gallican principles; but the Ultramontanes allege that the principles laid down by him as to the authority of the pope are only applicable to the exceptional case in which he wrote—viz. that of a disputed succession, in which the claim of each of the rival popes, and therefore of the existing papacy itself, was doubtful. See the studies by Charles Schmidt (Strasburg, 1839) and Schwab (Würzburg, 1858).

Gerstäcker, FRIEDRICH, a German novelist and writer of travels, was born at Hamburg, 10th May 1816. Animated with an irrepressible impulse for travel, he in 1837 went to New York, and began a six years' tramp through the United States, part of the time working at various trades, part of the time leading an adventurous life as a hunter in the forests. In 1843 he returned to Germany, and published *Streif- und Jagdzüge durch die Vereinigten Staaten* (1844), *Die Regulatoren in Arkansas* (1845), *Die Flusspiraten des Mississippi* (1848), &c. Leaving home again in 1849, he travelled round the world by way of America, Polynesia, and Australia, reaching Germany in 1852. Most of the years 1860–61 were spent in South America; in 1862 he accompanied Duke Ernest of Gotha to Egypt and Abyssinia; and in 1867–68 he undertook another long journey, visiting North America, Mexico, Ecuador, Venezuela, and the West Indies. Of this last he gave a description in *Neue Reisen* (1868). His best books include *Tahiti*, *Die Beiden Sträflinge*, *Unter dem Æquator*, *Gold*, *Inselwelt*, and *Um die Welt* (1847–48). His *Gesammelte Schriften* appeared in 44 vols. in 1872–79. Gerstäcker died at Brunswick, 31st May 1872. His works, of which several have been translated into English since 1847, owe their popularity to their simple, homely style, and to the vigour and truth of the descriptions and characters.

Gervas (*Stachytarpheta Jamaicensis*), a small verbenaceous shrub of the West Indies and tropical America. It is regarded as of high medicinal value, and was used by the Indian sorcerers as its ally the vervain was in Europe. It has also been introduced into Europe as Brazilian tea, and also frequently employed as an adulterant of tea proper.

Gervase OF CANTERBURY, a monk who wrote a painstaking and fairly trustworthy chronicle of the reigns of Stephen, Henry II., and Richard I., and also a history of the archbishops of Canterbury down to Hubert Walter. These works are valuable especially as elucidating the contemporary relations between church and state, though Gervase seems to have been animated throughout by a persistent dislike to the House of Anjou. The former was edited by Bishop Stubbs for the Rolls series (2 vols. 1879–80).

Gervase OF TILBURY, a historical writer, born probably at Tilbury in Essex about the middle of the 12th century, and often said, without any foundation, to have been a nephew of King Henry II. of England. He lectured on canon law at Bologna, and was, under the Emperor Otho IV., marshal of the kingdom of Arles, and lastly provost of the nunnery at Ebsdorf. He died about 1235. His chief work is his *Otia Imperialia*, composed about 1212 for the entertainment of his imperial patron; the first two books consisting of an abstract of geography and history, the third containing a collection of curious beliefs about the 'Veronica,' British sirens, the magnet, and the like. The non-historical portions of the work were edited by Felix Liebrecht (Hanover, 1856). The whole was printed admirably by Leibnitz in vol. i. of *Scriptores Rerum Brunsvicensium*. Many other works have been attributed erroneously to Gervase of Tilbury. A *Liber Facetiarum*, or book of anecdotes, he tells us he prepared for Henry II. of England.

Gervinus, GEORG GOTTFRIED, German historian, was born at Darmstadt, 20th May 1805. Though at first engaged in commerce, he contrived to pursue his studies privately, then at the universities of Giessen and Heidelberg. In 1836 he was appointed professor of History at Göttingen. Already he had begun to publish his *Geschichte der poetischen Nationalliteratur der Deutschen* (5 vols. Leip. 1835–42), which, under the new title of *Geschichte der Deutschen Dichtung*, reached a fifth edition under the care of K. Bartsch, 1871–74. In 1837 he was one of the seven Göttingen professors who signed the famous protest against the abolition of the Hanoverian constitution, in consequence of which he lost his chair, and was ordered to leave the country within three days. He went first to Darmstadt, then to Heidelberg, thence to Rome, and was in 1844 appointed honorary professor in Heidelberg. From this period his career was that of an active political writer in behalf of constitutional liberty. In July 1847 he helped to establish

the *Deutsche Zeitung* in Heidelberg, and next year was elected a member of the National Assembly by a district of Prussian Saxony. After the failure of the national democratic party in Germany, Gervinus returned disheartened to his literary pursuits, one of the fruits of which was his great work on Shakespeare (4 vols. 1849–52; 2d ed. 1872; Eng. trans. new ed. 1875), which may be regarded as on the whole the most important German contribution to Shakespearian criticism. The analyses of the characters show insight, learning, and much ingenuity; but the critic strains the interpretation in order to bring Shakespeare into harmony with his theory of him as the absolute and perfect dramatist. The book has been called in Germany the 'bulwark of Shakespearomania.' A later work was the *Geschichte des 19ten Jahrhunderts* (8 vols. 1856–66). Gervinus died at Heidelberg, 18th March 1871. See *Briefwichsel zwischen J. und W. Grimm, Dahlmann, und Gervinus* (ed. by Ippel, 1885).

Geryon, a fabulous three-headed being, possessing herds of splendid oxen, and said to be the son of a king of Hesperia. He figures in the story of Hercules.

Gesangbuch. See HYMNOLOGY.

Gesenius, FRIEDRICH HEINRICH WILHELM, one of the greatest of German orientalists and biblical scholars, was born at Nordhausen, 3d February 1786, studied at Helmstedt and Göttingen, and at Halle in 1810 became extraordinary, in 1811 ordinary, professor of Theology. Here he lectured for more than thirty years, broken only by the closing of the university during the war of liberation (1813–14), and by lengthened visits to France and England in 1820, to England and Holland in 1835. Among his pupils were Von Bohlen, Hoffmann, Hupfeld, Rödiger, Tuch, Vatke, and Benfey. He died October 23, 1842. His first great work was his *Hebräisches u. Chaldäisches Handwörterbuch* (1810–12; 10th ed. revised by Mühlau and Volck, 1886; Eng. trans. by Tregelles, 1846–52). His *Hebr. Elementarbuch*, consisting of the *Hebräische Grammatik* (1813; 24th ed. by Kautzsch, 1885) and the *Hebräisches Lesebuch* (1814; 11th ed. by Heiligstedt, 1873), has contributed enormously to the knowledge of the Hebrew language, not only in Germany, but through translations also in England and America. Later works are his *Kritische Gesch. d. Hebr. Sprache u. Schrift* (1815), *De Pentateuchi Samaritani Origine, Indole, et Auctoritate* (1815), *Grammatisch-kritisches Lehrgebäude d. Hebr. Sprache* (1817), and a new translation of and commentary on Isaiah (1820–21). His greatest work is the monumental *Thesaurus philologico-criticus Linguæ Hebraicæ et Chaldaicæ Veteris Testamenti*, of which the first part was published in 1829, but which was completed only in 1858 by Professor Rödiger. Many of the results of the rationalising method of interpreting the Old Testament, which characterises all the works of Gesenius, have been unable to stand the test of progressive modern biblical science. He has certainly been surpassed by Ewald in insight into the genius of the Hebrew language, and its bearing on the interpretation of Hebrew life and thought, as well as in all that qualifies the critic for a true historical, æsthetical, and religious appreciation of the literature preserved to us in the Old Testament. Yet his intense devotion to his favourite studies, and the advance which he made beyond all his predecessors in the establishment of more certain principles of Hebrew philology, undoubtedly entitle him to be regarded as having constituted a new epoch in the scientific study of the Old Testament. A fine sketch of his life was published at Berlin in 1843.

Gesner, KONRAD VON, a Swiss naturalist, sometimes called the German Pliny, was born at Zurich, 26th March 1516. All his life long he was passionately devoted to the pursuit of knowledge, especially knowledge of the natural sciences. His early studies, in medicine, natural history, and Greek and Latin literature, were prosecuted at Zurich, Strasburg, Bourges, and Paris. Returning home in 1535, he earned his living by teaching, until in 1537 he was appointed professor of Greek at Lausanne. This chair, however, he exchanged four years later for that of Physics and Natural History at Zurich, where he taught and practised as a physician until his death, on 13th December 1565. He was also an indefatigable writer of books, and in the course of his life published no less than seventy-two works, besides leaving at his death eighteen others in progress. His *Bibliotheca Universalis* (1545) contained the titles of all the books then known in Hebrew, Greek, and Latin, unpublished as well as published, with criticisms and summaries of each; its second part, *Pandectarum sive Partitionum Universalium Libri XXI.*, came out in 1548–49. His next undertaking, by far the greatest of his literary works, was the *Historia Animalium* (1551–58). The first book treats of viviparous quadrupeds, the second of oviparous animals (tortoises, lizards, &c.), the third of birds, and the fourth of fishes and aquatic animals. Two other books, never completed, were to have contained the history of serpents and insects. In this work, which will ever remain a monument of his untiring industry, he aimed at bringing together all that was known in his time concerning every animal. But botany was probably the section of natural history with which he had the greatest practical acquaintance. He had collected more than five hundred plants undescribed by the ancients, and was arranging the results of his labours in this department for a third *magnum opus* at the time of his death. He appears to have been the first who made the great step towards a scientific classification of distinguishing genera by the fructification. He also wrote on other branches of science, as medicine and mineralogy, and composed a great number of works dealing with the ancient classics, the *Mithridates sive de Differentiâ Linguarum* (1555) being the most notable. See Hanhart's *Konrad Gesner* (Winterthur, 1824).

Gesneraceæ, a sub-order of Scrophulariaceæ, including about 700 species, mostly herbs, chiefly of tropical America. They are frequently noted for the beauty of their flowers, notably Gloxinia, Achimenes, and other common inmates of our greenhouses. *Fieldia africana*, however, yields the so-called African Teak. Of the closely allied Crescentiaceæ, the Calabash Tree (q.v.) is of most importance.

Gessler, the name given to the tyrannical governor in the story of William Tell (q.v.).

Gessner, SALOMON, a German pastoral poet, who also painted and engraved landscapes, was born at Zurich, 1st April 1730. His life was spent as a bookseller in his native town, where he died, 2d March 1788. In 1754 he published *Daphnis*, a conventional bucolic, sentimental, sweetly insipid, lifeless, and unreal. This was followed two years later by a volume of *Idyls* and by *Inkel und Yariko*. His *Tod Abels* (the Death of Abel), a species of idyllic heroic prose poem, which was published in 1758, although the feeblest of his works, had the greatest success, and helped to make its author's name known throughout Europe. Gessner's landscape-paintings are all in the conventional classic style. But his engravings are of real merit; some of them are said to be worthy of the first masters. In 1772 he published a second volume of *Idyls*, and a series of letters on landscape-painting.

Gesta Romanorum ('the deeds of the Romans'), the title of a collection of short stories and legends, in the Latin tongue, widely spread during the middle ages, but of the authorship of which little is known save that it took its present form most likely in England about the end of the 13th or the beginning of the 14th century. The stories are invariably moralised, and indeed the edifying purpose throughout is the sole unifying element of the collection. The title is only so far descriptive as the nucleus of the collection consists of stories from Roman history, or rather pieces from Roman writers, not necessarily of any greater historical value than that of Androcles and the lion from Aulus Gellius. Moralised mystical and religious tales, as well as other pieces, many of ultimate oriental origin, were afterwards added, and upon them edifying conclusions hung but awkwardly, bringing the whole up to about 180 chapters. Oesterley supposes its origin to have been English: the claims to its authorship of the Benedictine prior at Paris, Petrus Berchorius (died 1362), or of a certain Helinandus, may safely be set aside. The style and narrative faculty displayed deserve but *little commendation, but the book has a unique* interest as at least the immediate source of many stories that have filled a large place in literature. It is enough to mention the stories 'Of Feminine Subtlety' (120), retold in verse by Hoccleve; 'Of the Coming of the Devil, and of the Secret Judgments of God' (80), the story of Parnell's *Hermit;* 'Of Women who not only betray secrets, but lie fearfully' (125), the story of the sixty black crows, the foundation of Dr Byrom's clever poem, *The Three Black Crows;* 'Of too much Pride, and how the Proud are frequently compelled to endure some notable humiliation' (59), a story of the Emperor Jovinian, the same as that of King Robert of Sicily as versified by Longfellow; 'Of the Transgressions and Wounds of the Soul' (102), the same as 'The Leech of Folkstone' in the *Ingoldsby Legends;* 'Of Mental Constancy' (172), a version of the romance of *Guy of Warwick;* and 'Of Ingratitude' (25), and 'Of Constancy' (66), together supplying the groundwork of Rossetti's poem, *The Staff and Scrip.* Here also may be found what are substantially the same stories as Chaucer's *Man of Lawes Tale,* and Shakespeare's *King Lear* and *Merchant of Venice.* One tale, 'Of the Game of Schaci' (166), is a somewhat obscure description of the game of chess. The longest story, 'Of Temporal Tribulation' (153), is that of the adventures of Apollonius of Tyre, his wife and daughter, as in Gower's *Confessio Amantis,* and in *Pericles.* Gower, however, took it from the *Pantheon* (end of the 13th century) of Godfrey of Viterbo. Enough has been said to show that great part of the stories belong alike in form and substance to the ancient story-stock of Europe, and hence the book must be studied side by side with the romance of *Barlaam and Josaphat,* the *Disciplina Clericalis* of Petrus Alphonsus, the *Otia Imperialia* of Gervase of Tilbury, Voragine's *Golden Legend,* the *Speculum Historiale* of Vincent of Beauvais, and the medieval fables connected with the name of Æsop, no less than with such works of literary elaboration as the *Arabian Nights,* the *Talmud,* the *Fabliaux,* the *Decameron,* and the *Canterbury Tales.*

The stories in the *Gesta Romanorum* are mostly bald and inartistic, seldom if ever relieved by a touch of pathos or a gleam of humour, and never by any chance reaching the region of the really dramatic; yet they have a rare literary charm of their own in their utter naïveté and artlessness, as well as in the beautiful simplicity of their moralisations, based on a piety that questions nothing or finds relief in an unfathomed mysticism. Some of the best stories are those that gird at the weaknesses or faults of women—a direction in which monkish wit was ever prone to turn.

The modern form of the *Gesta Romanorum* is, as has been said, a collection of 181 stories, first printed about 1473, but no MS. corresponding exactly to which now exists. The first printed edition was issued at Utrecht in 150 chapters; the second, forming the standard text, within 181 chapters, at Cologne. Although both of these are undated, Oesterley proves that their publication falls between 1472 and 1475. An edition in English was printed by Wynkyn de Worde (1510–15), from MSS. differing widely from those reproduced in the early printed Latin versions. Oesterley divides the numerous MSS. into three groups or families: (1) the English group, written in Latin, the best representative of which has 102 chapters, of which 72 are found in the standard text; (2) the group of German and Latin MSS., represented by an edition printed in German at Augsburg in 1489; and (3) a group of MSS. represented by the standard text, influenced by distinct collections of stories, as Robert Holkot's *Moralisationes Pulchræ in Usum Prædicatorum* and the like. The striking diversity between the MSS. in England and the printed collections led Douce to believe that there were two distinct collections of stories, one of German, the other of English origin. Oesterley's conclusion is that this *Gesta* was originally compiled in England, that it passed quickly to the Continent, was there altered considerably before being printed, and that both the two first printed editions were compiled from several MSS. The second (the standard) form was the largest, and, reaching England before any of the native MSS. had been printed, became accepted as the standard form for the printed text, spite of its many divergences from the MSS. that still existed.

An English version by the Rev. C. Swan was printed in two volumes in 1824; in a revised form, by Wynnard Hooper, in Bohn's 'Antiquarian Library,' in 1877. Sir F. Madden edited *The Early English Versions of the Gesta Romanorum* for the Roxburghe Club in 1838, Mr Sidney J. H. Herrtage for the Early English Text Society in 1879. Critical editions of the Latin text have been edited by A. Keller (Stuttgart, 1842), and H. Oesterley (Berlin, 1872), the last with a masterly introduction. See also the Dissertation in Warton's *History of English Poetry,* and in vol. ii. of Douce's *Illustrations of Shakespeare;* but these must not now be followed implicitly.

Gestation, the retention of the mammalian embryo in the uterus. The period of gestation—i.e. between the fertilisation of the ovum and the extrusion of the fœtus—varies greatly, from about 18 days in the opossum and 30 in the rabbit to about 280 in man and 600 in the elephant. Robert Chambers in his *Vestiges of Creation* emphasised the importance of prolonged gestation as a factor of evolution, and it is certain that the more highly evolved mammals have longer periods of pregnancy than the lower. The size of the animal, the number of offspring at a birth, and the degree of their maturity at birth have also to be considered: thus, the gestations of cow and sheep last about 280 and 150 days respectively, those of mare and bitch about 350 and 60 days, those of giraffe and kangaroo about 420 and 40 days respectively. In the Marsupials, where the placental union between mother and offspring is still undeveloped, the birth is almost always very precocious, but in most cases the young are stowed away after birth in the external pouch. The lowest mammals—duckmole and Echidna—are oviparous. See FŒTUS, MAMMALIA, PLACENTA, PREGNANCY, REPRODUCTION.

Getæ, a people of Thracian extraction, who are first mentioned in history as dwelling on the right bank of the Danube, but who in the middle of the 4th century B.C. crossed that river and settled in

Transylvania and Wallachia. They were conquered by Darius Hystaspes in 515 B.C., and then accompanied him in his campaign against the Scythians. Both Alexander the Great, in 335, and Lysimachos, in 292, made attempts to subdue them, but neither was successful. During the first half of the 1st century B.C. they became politically united with the Dacians, a cognate race who had settled in their territories. The Getæ, as distinct from the Dacians, sided with Octavius against Antony, and during the greater part of the 1st century after Christ continued to harass the Roman legions. In 106 B.C. the Dacians and Getæ were subdued by Trajan, their country being added to the empire. Subsequently the Getæ became fused with the Goths (q.v.), who invaded their lands, and afterwards carried many of them with them in their westward migrations.

Gethsemane (Heb. *gath*, 'a wine-press,' and *shemen*, 'oil'), the scene of our Saviour's agony on the night before his Passion, was a small farm or estate at the foot of Mount Olivet, somewhere on the east slope of the Kedron valley, and rather more than half a mile from the city of Jerusalem. Attached to it was a garden or orchard, a favourite resort of Christ and his disciples. The place is not now exactly known, but an enclosure with a few old olive-trees is pointed out to travellers as the site of the garden.

Gettysburg, capital of Adams county, Pennsylvania, built on several hills, 50 miles by rail SSW. of Harrisburg. It contains a Lutheran college (1832) and seminary (1826). Pop. 2814. Gettysburg was the scene of one of the great battles of the civil war, on 2d and 3d July 1863, when General Meade gained a hard-fought victory over the Confederate General Lee. Near the town there are numerous monuments commemorating incidents of the battle; and in the national cemetery is a national monument of granite, 60 feet high.

Geulincx, or GEULINGX, ARNOLD, a Dutch philosopher, one of the disciples of Descartes (q.v.), and a leading exponent of the speculative doctrine known as Occasionalism. Very little that is authentic is known about his life. He was born at Antwerp in 1625; for twelve years, from 1646, he lectured successfully at Louvain, was then deposed for some reason not ascertained, and, after living at Leyden in great distress, was in 1665 appointed professor of Philosophy there, but died four years later. His ideas are expounded in books entitled *Saturnalia*, *Logica*, *Ethica*, published in his lifetime, and in *Annotata præcurrentia ad Cartesii Principia* (1690) and *Metaphysica Vera* (1691), which appeared after his death. The salient point of his teaching is an endeavour to explain the relations which obtain between soul and body, the mutual interaction of which under stimulus he ascribed to divine intervention and preordained arrangement. See works by Grimm (Jena, 1875), Pfleiderer (Tüb. 1882), and Samtleben (Halle, 1886).

Geum, a genus of Rosaceæ, sub-order Potentilleæ, distinguished from Potentilla by the hardened hooked styles which crown the carpels, so that the fruit becomes a bur. Two species are common natives of Britain, *G. urbanum*, the Wood Avens or Herb Bennet, and *G. rivale*, Water Avens, the former with erect yellow flowers, and the latter with nodding flowers of a brownish hue. The former grows in hedges and thickets, the latter in wet meadows and woods, and sometimes even in very alpine situations. The so-called *G. intermedium* is usually regarded as a mere hybrid of these two species. Both are aromatic, tonic, and astringent, and of old repute among herbalists; the rootstock of the former was formerly gathered in early spring to impart its clove-like flavour to ale, and is still used in the preparation of liqueurs. *G. canadense*, the Chocolate Root or Blood Root of North America, has some reputation as a mild tonic.

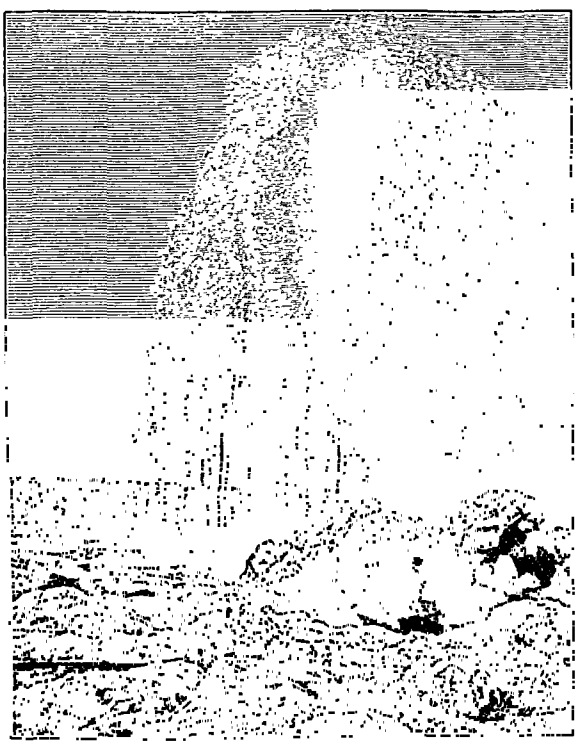
Water Avens (*Geum rivale*).

Geyser, or GEYSIR (Icelandic *geysa*, 'to burst out violently'), is the name applied to eruptive fountains of steam and hot water met with in various quarters of the globe, especially in Iceland, North America, New Zealand, Tibet, and the Azores. The water of these springs is often clear and limpid, but frequently thick, turbid, and heavily charged with mud; examples of the latter have been discovered in Burma. The mineral substances held in solution in geysers are numerous and varied in character, including sodium chloride, calcium sulphate, sodium sulphate, calcium carbonate, magnesium carbonate, ammonium carbonate, potassium chloride, silica, various silicates, sulphur, ferric oxide, aluminium oxide, carbonic acid, &c. Some of these substances, becoming separated from the water by evaporation, form basin-shaped cones of solid matter, from the midst of which the geyser rises, and in course of time assume proportions of considerable magnitude; the cones are principally of a calcareous or siliceous character, the latter, known as siliceous sinter or geyserite, being apparently most common. It is either a compact, dull, sometimes, but less frequently, translucent laminated substance, or shapeless, porous mass, occasionally impregnated with ferric oxide, which produces a red or pink tinge.

Geysers occur only in regions where volcanic activity has but lately become dormant, but is not yet altogether extinct, and the phenomena connected with them are connected with seismic action. Bunsen and Descloizeaux have formulated a theory explaining the phenomena, which has met with wide acceptance and is generally preferred to the views held by such authorities as Bischof, Mackenzie, Herschel, Von Nidda, and others. Shortly stated, the explanation put forward by the two former is as follows, founding upon observations made at the Great Geyser of Iceland. In the tube of this geyser, and near the surface, the water temperature is 212° F., increasing downwards until a degree of heat is reached very far above the boiling-point of water under ordinary atmospheric pressure, fluidity being maintained by the weight of the column of water above. The water in the tube or funnel of the geyser communicates with an area directly acted upon by the source of the subterranean heat, such communication being attained by means of a lateral chamber or passage. Far down in the funnel steam is generated, which, rising immediately into the cooler water above, is condensed, heating the upper water until the boiling-point is reached, and relieving the pressure upon the lower portions of the greatly heated water, which flashes into steam. This alteration passing down the funnel results in closely following explosions of steam, shooting the whole contents high into the air, and producing the well-known outward manifestations associated with geysers.

These manifestations are most frequently met with where large masses and thicknesses of rock have undergone extensive crushing, fracture, and compression—which may account not only for the subterranean heat, but also for the presence of the underground passages apparently necessary for the production of a geyser.

The geysers of the Yellowstone region are probably the most picturesque and wonderful in the world: on the Firehole River alone, within an area of 30 sq. m., there are probably 50 geysers, throwing columns of water to a height of from 50 to 200 feet, while smaller jets rise occasionally to 250 feet. The 'Old Faithful' geyser, in this region, throws up a column of water 6 feet in diameter to a height of 100 to 150 feet, at intervals of about an hour. Near the north entrance to the National Park, also, are the hot springs of the Gardiner River; here the 'White Mountain,' built up of terraces of white calcareous deposits, rises to a considerable height, with a diameter of 150 yards at the top. The terraces are of varying width, measuring from a few inches to many feet, and are separated one from another by small cliffs of from 6 inches to 10 or 12 feet in height. From the top of the mound water is continually trickling down over these rocks and terraces, the precipitate left behind ever slowly adding to the bulk of the cone. As the streams fall from terrace to terrace they are received into several natural basins, and, as the water gradually cools as it nears the bottom, bathers are enabled to choose almost any temperature of water, and these natural baths are largely taken advantage of. See YELLOWSTONE.



'Old Faithful' Geyser.

The geysers of Iceland are situated within sight of Mount Hekla, 16 miles north of Skalholt, and are the hottest springs in Europe, as well as the best known in the world. Norwegian writers of the 12th century noted their presence, but it was nearly 600 years later before native authors described or noticed them in any way. The principal geysers of this region are known as the 'Great Geyser' or 'Roarer,' and the 'Stroker' or 'Churn.' The former consists of the usual mound of siliceous incrustations, almost circular and about 40 feet in height, the top forming a basin measuring 52 feet by 60 feet, lined with a pure white siliceous coating of considerable hardness. A tube, 74 feet in length, communicates with the interior of the geyser, the upper opening being in the centre of the basin. There can be no doubt that the geyser has itself built up the tube and mound—a work, according to careful calculations and experiments undertaken on the spot in 1859 by Commander Forbes, which must have occupied over eleven centuries. Probably the best account of this geyser is that of Henderson, who visited the district in 1814. The 'Churn' has an irregular opening, not more than eight feet wide, the tube decreasing in width as it descends, permitting one to look down upon the boiling water 20 feet below without much danger to the observer. If the orifice be temporarily choked by throwing in turf the water will soon burst through, rising 60 feet into the air, carrying the obstruction along with it, and diffusing dense clouds of steam in all directions.

The geysers of New Zealand attained celebrity principally on account of the beautiful terraces associated with them, and have often been described and figured. Unfortunately, volcanic activity manifested itself throughout the region in June 1886, resulting in much loss of life and property, and in the destruction of the terraces. The basins connected with these geysers, catching the overflow of water, are, like those of the Yellowstone region, largely used by bathers, and are much resorted to by invalids. Froude and Martin may be consulted for descriptions of typical New Zealand geysers. See MINERAL SPRINGS.

Gfrörer, AUGUST FRIEDRICH, a German historian, was born at Calw, in the Black Forest, 5th March 1803. He studied theology at Tübingen, next lived at Lausanne, Geneva, and Rome, becoming on his return in 1828 a *Repetent* at Tübingen, and in 1830 librarian at Stuttgart. He now gave himself with much zeal to historical studies, of which the first fruit was his *Philo und die Jüdisch-Alexandrinische Theosophie* (1831), followed by *Gustav Adolf* (1835), a work which aimed at bringing into prominence the political rather than the religious rôle of the great Swedish king. His *Geschichte des Urchristenthums* (1838) was called forth by the greater work of Strauss. In his *Allgemeine Kirchengeschichte* (1841–46), coming down to 1305, he first spoke out his admiration for the polity of the Roman Church. Soon after he was called to the chair of History at Freiburg, and in 1848 he was sent to the Frankfort parliament, where he was one of the most decided adherents of the party called the *Grossdeutschen*, the fanatical opponents of Prussia. He formally went over to Rome in 1853, and thereafter was distinguished by his large share of the intolerance of the convert, although all the while he was never a dogmatically satisfactory Catholic. He died at Carlsbad, July 6, 1861. His most important other works were *Geschichte der Karolinger* (1848) and *Papst Gregorius VII.* (1859–61). All his works are learned, often perversely so; his conclusions are too often more ingenious than sound.

Ghadames. See GADAMES.

Ghara is the name sometimes given to the united stream formed by the junction of the Sutlej

and the Beas, from Endrisa to the junction with the Chenab, when it becomes known as the Panjnad. The distance between the two points of confluence is about 300 miles.

Ghasel, or GHAZEL, a favourite form of lyrical poetry among the Turks and Persians, which may be either erotic and bacchanalian, or allegorical and mystical.

Ghâts, or GHAUTS (in English, 'gates, passes, or landing-stairs'), EASTERN and WESTERN, two converging ranges of mountains, which run parallel with the east and west coasts of southern India, and meet at an angle near Cape Comorin. (1) The Eastern Ghâts commence in the vicinity of Balasor, a little north of the Mahanadi, and run through Madras, with an average height of 1500 feet, for the most part at a distance of from 50 to 150 miles from the coast. They are nowhere a watershed on any considerable scale, being penetrated and crossed by nearly all the drainage of the interior. (2) The Western Ghâts stretch from the valley of the Tapti, in about the same latitude as Balasor, to their junction with the kindred ridge, and on to Cape Comorin itself. Though they are generally far more continuous and distinct than the Eastern Ghâts, yet they are sharply divided by the gap of Palghât—the northern section measuring 800 miles in length, and the southern 200. Their general elevation varies from about 3000 feet to upwards of 7000; the peak of Dodabetta, in the Nilgiri hills, is 8760 feet above sea-level. The opposite faces of these mountains differ very remarkably from each other. Landward, there is a gradual slope to the tableland of the Deccan; seaward, almost perpendicular precipices, speaking generally, sink at once nearly to the level of the sea, with only a comparatively narrow strip between them and the shore. This peculiarity, along with the heavy rainfall brought by the south-west monsoon, causes, more particularly towards the south, that singular feature of the country which is known as the 'backwaters' (see COCHIN). The Western Ghâts are a watershed, for not a single stream of any magnitude finds its way through them. Their vast primeval forests display some of the most magnificent scenery in India, and supply abundance of the finest timber. In the south there is a railway from Beypur to Madras, finding a comparatively easy access to the interior by the Palghât valley. In the north, near Bombay, two railways scale the precipitous face of the Western Ghâts. Of these the line up the tremendous ravine of the Bhor Ghât, 40 miles SE. of Bombay, is regarded as one of the greatest engineering feats ever accomplished in India. The railway rises by a lift of 15½ miles to a height of 1831 feet, twisting round the mountains on narrow ledges that are often half embankment, or that rest on high vaulted arches, and passing through tunnels that aggregate 2535 yards. Besides 8 viaducts there are 18 bridges and 58 culverts, and the average gradient is 1 in 48.

The name GHÂTS is also applied to the flights of steps, whether intended as landing-places or as bathing-stairs, which line the river-banks in towns and places of pilgrimage in northern and central India. Most great rivers, and especially the Ganges, possess many ghâts; but they are also built on the margins of lakes, as at Pushkar and Sagar, or even of tanks. The uniformity of the long lines of steps is often broken by shrines or temples, built either close to the water's edge or at the top; and on these steps are concentrated the pastimes of the idler, the duties of the devout, and much of the necessary intercourse of business. The ghâts of Benares (q.v.), Hardwar, Panharpur, and of Maheswar, on the Nerbudda, are noteworthy either for their number or beauty; while Cawnpore, Sadullapur, the ruined city of Gaur, and other places possess noted 'burning ghâts' for purposes of cremation. See also Fergusson's *Handbook of Architecture.*

Ghazali, ABU MOHAMMED AL-, known in the West as ALGAZEL, a Moslem theologian who, in the 11th century, struck a serious blow at the scholastic philosophy of the Arabians. Born at Tus in Khorasan in 1058, he studied in his natal city and at Nishapur, being especially nurtured on the principles of Sufism (q.v.). When thirty-three years old he was appointed by the grand-vizier of Bagdad to a chair of philosophy in the university of that city. But four years later he set off for Mecca; then spent ten years lecturing at Damascus; and finally went on to Jerusalem and Alexandria, where also he taught with signal success. In the end, however, he returned to Tus, where he founded a Sufic college and dedicated the remainder of his life, until 1111, the year of his death, to religious and philosophic contemplation. The most notable of his numerous works are *Opinions of the Philosophers* and *Tendencies of the Philosophers,* this latter virtually an introduction to the more famous *Destruction of the Philosophers,* in which he challenges the methods and conclusions of the current scholasticism of Arabian philosophy. He also wrote a commentary on the ninety-nine names of God, several ethical treatises, and various other works on religion and philosophy. Several of his works have never yet been published.

Ghaziabad, a town and important railway junction in Meerut district, North-west Provinces of India, 28 miles SW. of Meerut, with barracks, and a considerable trade in grain, hides, and leather. Pop. 12,059.

Ghazipur, a city of India, capital of a district of the same name in the North-west Provinces, stands on the left bank of the Ganges, 44 miles NE. of Benares. The city, which stretches along the Ganges for about 2 miles, contains the ruins of the Palace of Forty Pillars, and a marble statue by Flaxman to Lord Cornwallis, who died here in 1805. Ghazipur is the headquarters of the Government Opium Department for the North-west Provinces, all the opium from these provinces being manufactured here, and there is some trade in sugar, tobacco, rose-water, and coarse long-cloth. Pop. (1881) 43,232.—The *district,* of which Ghazipur is the administrative headquarters, has an area of 1473 sq. m., and a pop. of (1881) 1,014,099.

Ghazni (also spelt *Ghizni* and *Ghuznee*), a fortified town of Afghanistan, stands below a spur of a range of hills, at an elevation of 7729 feet, 84 miles SW. of Kabul, on the road to Kandahar and at the head of the Gomal route to India. It is a place of considerable commercial importance. The climate is cold, snow often lying for three months in the year. Nevertheless, wheat, barley, and madder are grown in the vicinity. Its population is estimated at about 10,000. From the 10th to the 12th century Ghazni was the capital of the empire of the Ghaznevids (see below); it then fell into the hands of the sultan of Ghûr, and enjoyed a second period of splendour. Having shortly afterwards been captured by the Mongols, it rapidly fell into decay. It remained, however, subject to the descendants of Baber, the Mongol rulers of Delhi and Agra, down to 1738, when it was taken by Nadir Shah of Persia, and at his death was incorporated in the kingdom of Afghanistan. During the 19th century it figured in the British wars against the Afghans, having been stormed by Lord Keane in 1839, and again in 1842 by the Afghans, but retaken the same year by General Nutt. In the neighbourhood of Ghazni

there are several ruins and monuments of its former greatness, such as the tomb of Mahmud, Mahmud's dam in the Ghazni River, numerous ruin-heaps north-east of the town, and many Mohammedan shrines. The celebrated gates of Somnath (q.v.) were kept at Ghazni from 1024 to 1842.

Ghaznevid Dynasty.—About the middle of the 10th century a lieutenant of the Samanid ruler of Bokhara seized upon Ghazni, and, dying in 977, left it to his son-in-law, Sebuktagin, who during a reign of twenty years extended his sway over all modern Afghanistan and the Punjab. But it was under his son Mahmud (997–1030) that the Ghaznevids reached their highest point of splendour and renown. This prince repeatedly invaded India, and carried his conquering arms as far as Kurdistan and the Caspian on the west and to Samarkand on the north. He was the first monarch in Asia to assume the title of sultan. His descendants had a keen struggle to maintain themselves against the Seljuks, who had seized upon Khorasan, Balkh, Kharezm, and Irak during the reign of Mahmud's son Masaud (1030–42), and against their jealous rivals the princes of Ghûr (q.v.). Bahram Shah, ruler of Ghazni from 1118 to 1152, was at length driven from his capital by the latter, and retired to the Punjab. There his grandson, Khosrau Malek, the last of the dynasty, made Lahore his capital. This town was, however, taken by the prince of Ghûr in 1186, and with this the Ghaznevid dynasty came to an end.

Ghee (*Ghi*), a kind of clarified butter used in many parts of India, and generally prepared from the milk of buffaloes. The fresh milk is boiled for an hour or more; it is then allowed to cool, and a little curdled milk, called dhye, is added to promote coagulation. The curdled mass is churned for half an hour; some hot water is then added, and the churning continued for another half-hour, when the butter forms. When the butter begins to become rancid, which is usually the case after a few days, it is boiled till all the water contained in it is expelled, and a little dhye and salt, or betel-leaf, is added; after which it is put into closed pots to be kept for use. It is used to an enormous extent by the natives of many parts of India, but is seldom relished by Europeans.

Gheel, a colony for the insane, in Belgium, 26 miles ESE. of Antwerp by rail. It is an oasis in a desert, a village and commune (20 miles in circumference) in a comparatively fertile spot, inhabited and cultivated by 11,000 peasants, in the midst of an extensive sandy waste, called the Campine (see BELGIUM). Here in 600 A.D. St Dymphna, an Irish princess, is said to have been beheaded by her father, for resistance to his incestuous passion. Pilgrims, the sick, the sorrowful, and the insane, visited the shrine of the Christian virgin; the last were restored to sanity and serenity. About 1300 insane persons are lodged with the citizens of this community, and are controlled and employed by them, and this without recourse to walls or other asylum appliances, and with little coercion of any kind. The quieter sufferers reside generally one in each family in the village, the more excited in separate farmhouses at some distance on the confines of the commune, while those requiring medical treatment are temporarily accommodated in the infirmary in Gheel. The support of the patients is in most cases guaranteed by the state. See works in French on Gheel and the 'Gheel system' by Duval (1867) and Peeters (1879).

Ghent (Flem. and Ger. *Gent*, Fr. *Gand*), a city of Belgium, capital of the province of East Flanders, is situated at the confluence of the Lys and the Scheldt, 34 miles by rail NW. of Brussels. It is divided by canals into 26 islands, connected by 270 bridges, and is encompassed with gardens and meadows, while the former walls have been converted into pleasant promenades. It is in general well built; but in the older part it still retains several quaint and picturesque houses. Among the chief buildings are the cathedral of St Bavon, of the 13th and 14th centuries, counted amongst the finest churches of the country, and containing the 'Adoration of the Lamb,' by the brothers Van Eyck; the belfry-tower (1183–1339), 280 feet high, or 375 with the iron spire of 1855; the new citadel (1822–30); the hôtel-de-ville (1480–1628), one of the most florid specimens of flamboyant Gothic in Belgium; the Palais de Justice (1835–43), with a peristyle of the Corinthian order; the university (1816), the Béguinage (q.v.), and the Academy of Painting. The cotton, woollen, and linen manufactures are the chief industries. Leather, lace, and sugar are also manufactured, and there are foundries, machine-works, breweries, &c. Specially noteworthy is the floriculture of Ghent. By the Great Canal, which flows into the Scheldt, Ghent is united with the sea, and it can receive into its docks vessels drawing 17 feet of water. The harbour is capable of holding 400 vessels, new docks having been opened in 1881. Ghent is very rich in charitable and public institutions. With the university are united a school for civil engineers, another for arts and sciences, and the former town-library. Pop. (1846) 102,977; (1888) 147,912.

Ghent, whose patron-saint, the soldier-monk Bavon, is said to have died in 655, was certainly a prosperous city in the time of the Merovingian Franks. In 1007 it was given by the emperor to Count Baldwin IV. In the 12th century it was made the capital of Flanders. And under the counts it continued to prosper and increase, until, in the 14th century, it was able to send 80,000 men into the field, and to withstand, single-handed, the power of the count backed up by the king of France. The wealth of the citizens of Ghent, and the unusual measure of liberty which they enjoyed, encouraged them to resist with arms any attempt to infringe upon their peculiar rights and privileges. This jealous and turbulent spirit is exemplified in the famous insurrection of Jacob van Artevelde (q.v.), and other instances. John of Gaunt, i.e. Ghent, was born here in 1340. For many years the city maintained a vigorous resistance against the Dukes of Burgundy; and having rebelled against Charles V., their successor, in 1540 it was deprived of its privileges. From this time the town began to decay, and under Philip II. the Inquisition struck a yet deadlier blow at its well-being. In the various wars of which the Netherlands has been the battle-ground, Ghent has suffered severely, and has been frequently taken, especially in the 18th century. Falling into the hands of the French at the Revolution, it was made the capital of the department of the Scheldt, till its incorporation in the kingdom of the Netherlands in 1814, in which year was signed the peace of Ghent between Britain and America. In 1830 it fell to Belgium. See FLANDERS; also Van Duyse, *Gand, monumental et pittoresque* (Brussels, 1886).

Gherardesca. See UGOLINO.

Ghetto (Ital.), the Jews' quarter in Italian cities, to which they used to be strictly confined. The ghetto of Rome, instituted in 1556 by Pope Paul IV., was removed in 1885 and following years, its demolition having been rendered necessary by the new Tiber embankment. The term is also employed to indicate the Jews' quarters in any city. See JEWS.

Ghi. See GHEE.

Ghibellines. See GUELPHS.

Ghiberti, LORENZO, an Italian goldsmith, bronze-caster, and sculptor, was born at Florence about 1378. He was apprenticed to his stepfather, a skilful goldsmith, and also acquired dexterity in drawing, painting, and modelling. In 1400 he executed a noble fresco in the palazzo of Pandolfo Malatesta at Rimini. Along with other artists, he was next chosen (1401) by the Florentine guild of merchants to compete for the execution of a gate in bronze, to match that executed by Andrea Pisano in the baptistery in 1336. The subject of the design was 'The Sacrifice of Isaac,' to be executed in bas-relief as a model for one of the panels. The judges selected Ghiberti's design, both on account of the art and beauty of its conception and the delicacy and skill of its execution. When Ghiberti had completed this great work (1424) his fellow-citizens entrusted him with the execution of another gate, to emulate the two already adorning the baptistery. This second gate, finished in 1452, contains ten reliefs on a larger scale, the subjects in this case also being wholly biblical. The mingled grace and grandeur of these compositions is beyond all praise; though his treatment of bas-relief has been condemned as wrong in principle. On the two gates he spent fifty years of most patient labour. Not the least of Ghiberti's merits was the success that attended his efforts to break down the conventionalism that before his day hampered the free development of sculptural art. Among his other works may be mentioned the sepulchral monuments of Dati in Santa Maria Novella, and of the Albizzi in Santa Croce at Florence, executed about 1427; a bronze relief in the Duomo, representing St Zenobius bringing a dead child to life (1440); and between 1414 and 1422 bronze statues of St John the Baptist, St Matthew, and St Stephen for the church of Or San Michele. Ghiberti died at Florence, 1st December 1455. See Perkins, *Ghiberti et son École* (Paris, 1885).

Ghika, HELENA, Princess Koltzoff-Massalsky, better known by her literary pseudonym of *Dora d'Istria*, was a daughter of Prince Michael Ghika, was a niece of two hospodars of Wallachia, and was born at Bucharest, 22d January 1829. The family from which she was descended was Albanian in origin, and from the time of George Ghika, hospodar of Wallachia in 1660, gave many princes and eminent men to the principalities (see ROUMANIA). Profoundly instructed in the classics under the care of George Pappadopoulos, the princess added to her acquirements by travels through Germany, France, and Italy an extensive knowledge of modern languages and literature. At fifteen she commenced a translation of the *Iliad* into German, and not long after wrote several pieces for the theatre. On her unhappy marriage in 1849 with Prince Koltzoff-Massalsky she accompanied her husband to the court of St Petersburg; but from 1855 she resided mainly at Florence, where she died, 22d November 1888. Her first important work, *La Vie Monastique dans l'Église Orientale*, was published in 1855. Other works were: *La Suisse Allemande* (1856); *Les Femmes en Orient* (1860); *Excursions en Roumélie* (1863); *Aux Bords des Lacs Helvétiques* (1864); *Des Femmes, par une Femme* (1864); *Gli Albanesi in Rumenia; Storia dei Principi Ghika* (1873); *La Poésie des Ottomans* (1873). She wrote much for the *Revue des Deux Mondes* and other journals and magazines of France, Italy, Belgium, and Switzerland; and her writings on Albanian literature stirred up a notable literary and national movement amongst the Albanians. She was made a member of several learned societies, and an honorary citizen of the Greek kingdom. See Cecchetti, *Dora d'Istria* (1871), and an article in *Scribner's Magazine* for December 1878.

Ghilan', a province of Persia, the western portion of the narrow strip of country lying between the Elburz range and the Caspian Sea, is separated from Russian Caucasia on the north-west by the river Astara. Area, 4251 sq. m. Owing to the lowness of the land, the province is subject to frequent inundations, and during great part of the year is little better than a swamp. There are dense forests, chiefly of oaks, maples, ashes, limes, &c., and a tropical luxuriance of vegetation. Extensive plantations of fruit and mulberry trees are grown, these last for the production of silk. The soil is extremely fertile, bearing barley, wheat, fruits, and great quantities of rice. Animal life is abundant. The fisheries in the Caspian are very productive. The population, estimated at 150,000 to 250,000, are principally of Iranian descent, mingled with Kurdish and Turkic immigrants, and nearly all are Shiite Mohammedans. The climate is moist, changeable, and unhealthy. Storms are very violent.

Ghilzais, an Afghan tribe. See AFGHANISTAN.

Ghirlandajo. DOMENICO CURRADI, nicknamed Il Ghirlandajo ('the garland-maker'), Italian painter of the early Florentine school, was born in 1449 at Florence. As a youth he was apprenticed to a goldsmith, probably his father, the maker of metal garlands; and it was not until his thirty-first year that he became known as a painter. He painted principally frescoes, and in his native city. The church of Ognisanti there contains from his hand a St Jerome and a Last Supper (1480); the Palazzo Vecchio, the Apotheosis of St Zenobius (1481–85); the church of S. Trinità, six subjects from the life of St Francis (1485) and an altar-piece, the 'Adoration of the Shepherds' (now in the Florentine Academy); the choir of S. Maria Novella, a series illustrating the lives of the Virgin and the Baptist (1490). Between 1482 and 1484 he painted for Pope Sixtus IV., in the Sistine Chapel at Rome, the excellent fresco 'Christ calling Peter and Andrew,' and about the same time two pictures in the chapel of St Fina at San Gimignano. Besides these he also executed some easel pictures of great merit, as 'Adoration of the Magi' (1488), in the church of the Innocenti at Florence; the 'Visitation of the Virgin' (1491), in the Louvre; the 'Adoration of the Virgin by the Saints,' in the Uffizi at Florence; and 'Christ in Glory,' at Volterra. All these are painted in tempera, and are not free from a certain hardness of outline and of colour. His frescoes are generally characterised by excellent composition, good knowledge of perspective, strength in the outlines, except in the case of feet and hands, and propriety of expression, but often show a tendency to crudeness in colouring. Ghirlandajo inaugurated at Florence the practice of introducing into his sacred pictures portraits of his contemporaries; and the same fondness for local colour is frequently discernible in his landscape backgrounds. He also executed mosaics, that of the 'Annunciation' in the cathedral of Florence being especially celebrated. He died at Florence, 11th January 1494. Michel Angelo was for a time one of his pupils.

His son RIDOLFO (1483–1561) was a painter of considerable merit, whose best pictures are those which show the influence of Fra Bartolommeo and Raphael, such as two scenes from the 'Life of St Zenobius' (in the Uffizi), 'Ascension of the Virgin' (at Prato), and 'Adoration of the Shepherds' (1510, at Pesth).

Ghizeh. See GIZEH.

Ghizni. See GHAZNI.

Ghoorkhas. See GOORKHAS.

Ghost-moth (*Hepialus humuli*), a species of moth very common in many parts of Britain, of which the caterpillar, popularly known as the 'Otter,' often commits great ravages in hop gardens, devouring the roots of the plants. It feeds also on the roots of the nettle, burdock, and some other plants. The moth belongs to a small family (Hepialidæ), often popularly called *Swifts* from

Ghost-moth (*Hepialus humuli*): caterpillar (*a*) and chrysalis (*b*).

their rapid flight. The antennæ are short, the wings long and narrow, the entire size about two inches across. The male is entirely of a satiny white colour above, and the female yellowish and reddish with darker markings; both sexes are brown on the under side. They are to be seen flying about in the twilight, generally over lawns and pastures, not unfrequently in churchyards. From this circumstance, and from the white colour of the males and their sudden disappearance in the imperfect light on their folding their wings or rising above the level of the spectator's eye (so that the brown part is turned towards him), they derive their name. The caterpillar, which is sometimes two inches long, is yellowish-white, with scattered hairs. It spins a large cylindrical cocoon among the roots on which it has been feeding, and then becomes a chrysalis. Two other common species of generally similar habit are *H. lupulinus* and *H. hectus*.

Ghosts. See APPARITIONS.

Ghoul. See VAMPIRE.

Ghûr, or GHORE, a mountainous district of western Afghanistan, lying south-east from Herât and north-west from Kandahar. Roughly speaking, it coincides with the ancient Paropamisus and the medieval Gharshistan. It is a region, however, about which next to nothing is known, except that it is inhabited by Hazaras and Eimaks, and since 1845 has been included in the territory of Herât.

GHÛRI, a dynasty of princes who had the seat of their empire in the country of Ghûr, and ruled over Persia, Afghanistan, northern Hindustan, and Transoxiana. We first read of Ghûr in connection with Mahmud of Ghazni and his son Masaud, the latter of whom subjugated the region in 1020. About a century later Malik Izzuddin made himself ruler of all the Ghûr country. His son, Alauddin Jahansoz (the Burner), fell upon Ghazni, and took it and burned it to the ground. This prince's nephews, Ghiyassuddin and Muizuddin, established their power in Khorasan and Ghazni. The latter, crossing the Indus, then conquered successively the provinces of Multan (1176), Lahore (1186), and Ajmere (1190), and, in the course of the next six years, all Hindustan as far south as Nagpur and eastward to the Irawadi. It is from this epoch that the preponderance of Islam in Hindustan is dated. On the death of Muizuddin the Indian states asserted their independence, the power of the Ghûri being confined to Ghûr, Seistan, and Herât. This last feeble remnant was taken from them by the Shah of Kharezm about 1215. Some thirty years later the Ghûr princes managed to revive something of their former power at Herât, which they retained by sufferance from the Mongols down to 1383, when the city was captured by Timur, and the Ghûr sovereignty came to an end.

Gianibelli, FEDERIGO, a military engineer, born at Mantua about 1530. During the siege of Antwerp by the Spaniards in 1585 he destroyed, by means of an explosive ship, a bridge built by the latter across the Scheldt. Proceeding to England on the capitulation of Antwerp, he rendered great service in the preparations for resisting the Armada of 1588, by fortifying the Thames shore and devising the plan of sending the fire-ships into the enemy's fleet. He is said to have died in London, but when is not known.

Giannone, PIETRO, an Italian antipapal historian, was born 7th May 1676, at Ischitella, a village of Capitanata, in Naples. A barrister by profession, practising at Naples, he spent twenty years in the composition of a *magnum opus*, entitled *Storia Civile del Regno di Napoli* (4 vols. 1723). It led to his banishment; he took refuge at Vienna, Venice, and Geneva successively. Whilst at Geneva he published a bitter attack upon the papal pretensions in a work entitled *Il Triregno*. Then, being decoyed into Savoy in 1736, he was arrested and confined at Turin until his death, 7th March 1748. A collection of *Opere Postume* appeared after his death (Lausanne, 1760); and in 1859 Mancini issued his *Opere Inedite* (2 vols. Turin).

Giants. A giant (Gr. *gigas*) is an individual whose stature and bulk exceed those of his species or race generally. Until the beginning of the 19th century it was universally believed that giants, of a size far exceeding those who are exhibited in our times, formerly existed, either as nations or as individual specimens. This belief was based on the asserted discovery of colossal human bones, on supposed scriptural evidence, and on the evidence of various ancient and medieval authors.

A reference to the first volume of Cuvier's *Ossements Fossiles* will show that the bones of elephants, rhinoceroses, mastodons, &c. have been exhibited and accepted as evidence of prehistoric giants. Even so good a naturalist as Buffon fell into this popular delusion, and figured the bones of an elephant as the remains of human giants. Isidore Geoffroy Saint-Hilaire, in his *Histoire des Anomalies de l'Organisation*, notices several of the most famous of these cases.

The Scripture evidence, when carefully examined, does not amount to much. The Hebrew words *nephilim* and *gibborim*, which are translated *giants* in the Authorised Version ('nephilim' and 'mighty men' in the Revised Version), were apparently not giants in our sense of the word. The height of Og, king of Bashan, is not given; we are only told the length of his bed. The height of Goliath is put at six and a half cubits, but by Josephus and the Septuagint at four cubits and a span—say 8 feet 9 inches. The Anakim and other tall races referred to in Scripture need not have been of superhuman size.

The classical evidence is abundant, but obviously untrustworthy. Thus, besides Homer's allusions to